

# Science and Mathematics

School of Engineering, Nursing, and Science

## Purpose Statement

The Department of Science and Mathematics offers curricula in biology, chemistry, computer science, physics, mathematics, the earth-space sciences, and secondary science and mathematics education. The department seeks to present the natural sciences and mathematics as disciplines through which students can learn to understand creation and its Creator. They will learn how to exercise stewardship of this knowledge as professionals who seek to make a difference in their vocations for the glory of God and the benefit of family, church, community, and environment.

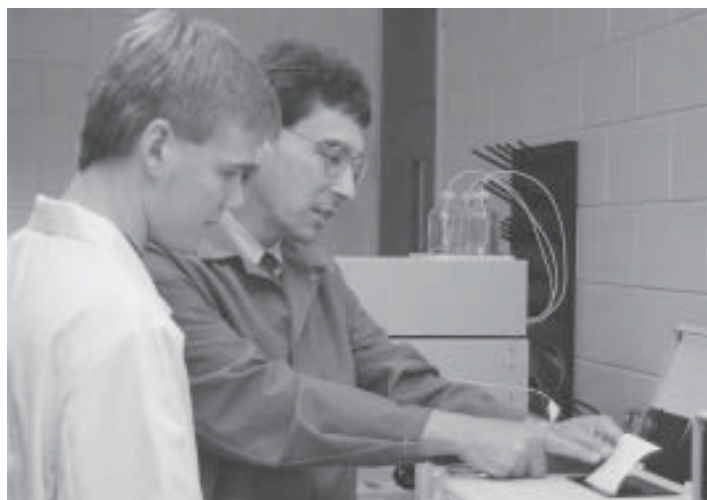
This department seeks to:

1. Provide a meaningful learning experience in the sciences and mathematics as part of the liberal arts core curriculum.
2. Aid students in developing clear and orderly thinking processes through the use of the techniques of science and mathematics.
3. Assist students in developing a biblical perspective of the sciences, which is essential in understanding the controversial issues such as origin of life, biomedical ethics, and genetic engineering.
4. Prepare students for graduate study or further professional study in the medical, environmental, or agricultural sciences.
5. Prepare secondary teachers with a biblical perspective of science.
6. Prepare students to serve in other science-related vocations.

## Personal Requirements

Students who enjoy and excel in high school mathematics and science courses possess the greatest potential for success as graduates of this department. Therefore, to prepare for the mathematics and science curricula, students should take a college preparatory curriculum which includes:

- Four units of English
- Four units of mathematics (algebra, geometry, and trigonometry)
- Four units of science (physical science, biology, chemistry, and physics)
- Three units of social science
- Three units of a single foreign language
- Electives in computers may also be helpful



Dr. Dennis Flentge, Chairman of the Department of Science and Mathematics, offers guidance and direction during a laboratory session.

## Department Requirements

### Programs of Study

The Department of Science and Mathematics offers the following programs of study:

#### Bachelor of Arts (B.A.) with majors in:

- Biology
- Chemistry
- Integrated Life Science Education
- Integrated Mathematics Education
- Integrated Physical Science Education
- Integrated Physics Education
- Integrated Science Education
- Mathematics
- Physics

#### Bachelor of Science (B.S.) with majors in:

- Biology
- Chemistry
- Computer Science
- Mathematics

#### Minors in:

- Biology
- Chemistry
- Computer Science
- Earth Science
- Mathematics
- Physics

#### Special programs:

- Environmental Biology
- Medical Technology
- Preagriculture
- Premedical (prehealth professions)
- Prepharmacy
- Prephysical Therapy

## Co-Curricular Opportunities

- Chi Theta Pi (pre-health professions organization)
- Earth Stewardship Organization
- Emergency Medical Services Squad
- Math Club
- ASME computing competition

## Technical Resources

- Molecular Modeling Software
- Laboratory simulations
- Biology and chemistry laboratory support
- Statistical Analysis Tools
- A.D.A.M. Interactive Anatomy™
- Maple 7™
- RASMOL™
- Chem Sketch™
- TeX™
- MicroCalc 7.0™
- DPGraph 2000™

## Career Opportunities

Graduates of this department have gained admission to outstanding graduate and professional schools around the nation. Careers pursued by graduates include:

- Agricultural consultant
- Biologist
- Botanist
- Business actuary
- Chemist
- Chiropractor
- College professor
- Computer scientist
- Environmental scientist
- Environmental toxicologist
- Health professional
- Laboratory technician
- Mathematician
- Pharmacist
- Physical therapist
- Physicist
- Physician
- Researcher
- Software engineer
- Software programmer
- Statistician
- Teacher
- Wildlife biologist

## Faculty

**Dennis Flentge**, *Chairman*, Professor of Chemistry. *Education*: B.S., Texas Lutheran College, 1969; Ph.D., Texas A&M University, 1974; Postdoctoral Research Fellow, University of Florida, 1974-75; Texas A & M University, 1976; Summer Faculty Research Fellow, Wright-Patterson Air Force Base, 1981, 1982, 1984-1988, 1990, 1996, 1997, 2001; graduate study, University of Wisconsin, summer, 1984. At Cedarville since 1980.

**Donald Baumann**, Professor of Biology and Chemistry. *Education*: B.S., Iowa State University, 1960; M.S., Iowa State University, 1962; Ph.D., Iowa State University, 1964. At Cedarville since 1964.

**Edwin Braithwaite**, Professor of Mathematics. *Education*: B.A., Western Washington University, 1966; M.A., Western Washington University, 1968; Ph.D., University of Illinois, 1975. At Cedarville since 1976.

**Xidong Chen**, Assistant Professor of Physics. *Education*: B.S., Shandong University, 1989; M.S., Institute of Physics, Chinese Academy of Sciences, 1992; Ph.D., University of Illinois, Urbana-Champaign, 1997; Postdoctoral Research Scientist, Argonne National Laboratory, 1997-2001. At Cedarville since 2001.

**Nigel Crompton**, Professor of Biology. *Education*: B.Sc. (Hons), Victoria University of Manchester, England, 1980; M.Sc., Victoria University of Manchester, England, 1982; Ph.D., Justus-Liebig University, 1987; D.Sc., University of Zurich, 1998; Postdoctoral research, Colorado State University, 1987-1989. At Cedarville since 2002.

**Leroy Eimers**, Professor of Physics and Mathematics. *Education*: B.S., Hobart College, 1963; M.S., Syracuse University, 1966; Ph.D., Syracuse University, 1970. At Cedarville since 1981.

**Darrin Frey**, Assistant Professor of Mathematics. *Education*: B.S., University of Nebraska, 1989; Ph.D., University of Michigan, 1995. At Cedarville since 1997.

**David M. Gallagher**, Associate Professor of Computer Science. *Education*: B.S., Electrical Engineering, United States Air Force Academy, 1978; M.S., Electrical Engineering, Air Force Institute of Technology, 1987; Ph.D., Electrical Engineering, University of Illinois, 1995. At Cedarville since 2000.

**Steven Gollmer**, Associate Professor of Physics. *Education*: B.S., Pillsbury Baptist Bible College, 1982; B.S., Northern Illinois University, 1985; M.S., University of Illinois, 1986; Ph.D., Purdue University, 1994. At Cedarville since 1994.

**Larry Helmick**, Professor of Chemistry. *Education*: B.S., Cedarville University, 1963; Ph.D., Ohio University, 1968; postdoctoral research, University of Florida, 1974-75 and summers of 1969, 1970, 1971; University of Illinois, summers of 1972, 1973, 1974; Summer Faculty Research Fellow, NASA-Lewis Research Center, 1980-1987 and 1990-1993, 1998; National Research Council Senior Research Fellow, 1988-1989; Wright Laboratory, Wright-Patterson Air Force Base, 1994-1997. At Cedarville since 1968.

**Andrew Heyd**, Instructor of Mathematics. *Education*: B.S., Cedarville University, 1999; M.S., Rensselaer Polytechnic Institute, 2001. At Cedarville University since 2002.

**William Jones**, Assistant Professor of Biology. *Education*: B.A., Cedarville University, 1981; M.A., University of Akron, 1999. At Cedarville since 1999.

**Heather Kuruvilla**, Assistant Professor of Biology. *Education*: B.S., Houghton College, 1992; Ph.D., State University of New York at Buffalo, 1997. At Cedarville since 1997.

**Dali Luo**, Assistant Professor of Mathematics. *Education*: B.S., South China Institute of Technology, 1982; M.S., Claremont Graduate School, 1988; Ph.D., Washington State University,

1992; Th.M., Grand Rapids Baptist Seminary, 1999. At Cedarville, 1992-1998, 2001.

**Mark McClain**, Assistant Professor of Chemistry. *Education*: B.A., Cedarville University, 1989; Ph.D., University of Michigan, 1994; Postdoctoral Fellow, Sandia National Laboratories, 1994-96; Summer Faculty Research Fellow, Air Force Research Laboratory, 1997, 1999, 2000, 2001, 2002. At Cedarville since 1996.

**Douglas Miller**, Professor of Chemistry. *Education*: B.S., University of Rochester, 1977; Ph.D., University of Colorado, 1981; postdoctoral research, University of Iowa, 1982; City University of New York, 1982-1984; Summer Faculty Research Fellow, NASA-Lewis Research Center, 1986-1990, 1992. At Cedarville since 1984.

**Terry Phipps**, Professor of Biology. *Education*: B.S., Cedarville University, 1970; M.S., Wright State University, 1974; Ph.D., The Ohio State University, 1987. At Cedarville since 1978.

**Kevin Roper**, Assistant Professor of Mathematics. *Education*: B.S., Southampton University (England), 1979; M.Ed., University of South Carolina, 1988; M.A., University of Kentucky, 1992; Ph.D., University of Kentucky, 1995. At Cedarville 1995-97, 2000.

**Alicia Schaffner**, Assistant Professor of Biology. *Education*: B.S., Purdue University, 1992; Ph.D., The Ohio State University, 2000. At Cedarville since 2000.

**Robert Schumacher**, Assistant Professor of Mathematics. *Education*: B.S., Computer Science, United States Air Force Academy, 1970; M.S., Operations Research, Air Force Institute of Technology, 1979. At Cedarville since 1993.

**John Silvius**, Professor of Biology. *Education*: B.A., Malone College, 1969; graduate study, Western Michigan University, 1970; Ph.D., West Virginia University, 1974; postdoctoral study, University of Illinois, 1974-76. At Cedarville since 1979.

**Dennis Sullivan**, Associate Professor of Biology. *Education*: B.S., Youngstown State University, 1974; M.D., Case Western Reserve University, 1978; Diplomate, American Board of Surgery, 1985; Fellow, American College of Surgeons, 1996. At Cedarville since 1997.

**Daniel Wetzel**, *Dean*, School of Engineering, Nursing, and Science. Professor of Physics and Mathematics. *Education*: B.S., Morehead State College, 1955; M.S., University of Cincinnati, 1963; Ph.D., The Ohio State University, 1971. At Cedarville since 1963.

**John Whitmore**, Assistant Professor of Geology. *Education*: B.S., Kent State University, 1985; M.S., Institute for Creation Research, 1991. At Cedarville since 1991.

**Otis Wright**, Associate Professor of Mathematics. *Education*: B.Sc., The University of Sydney, 1987; M.A., Princeton University, 1989; Ph.D., Princeton University, 1991. Postdoctoral research, University of North Carolina at Chapel Hill, 1998-1999. At Cedarville University since 2002.

**Cynthia Wingert**, Biology Laboratory Instructor. *Education*: B.A., Cedarville University, 2001; At Cedarville since 2001.

**L. Bert Frye**, Associate Professor Emeritus of Physical Science. *Education*: B.S., University of Missouri, 1940; graduate study, Faith Seminary, 1947-48; B.D., Grand Rapids Baptist Seminary, 1953; graduate study, Michigan State University, 1958-59, summer of 1961; University of California (Berkeley), summer of 1960; M.A.T., Miami University, 1964; University of Arizona, summer, 1969; State University of New York (Stony Brook), summer, 1970. At Cedarville from 1961 to 1981.

## Technical Support Staff

**Gordon Dingeldein**, Science Laboratory Technician. *Education*: B.S., Southern Illinois University, 1964. At Cedarville since 1996.

# Science and Mathematics

## School of Engineering, Nursing, and Science

### Biology–Bachelor of Arts

The bachelor of arts degree with a major in **biology** provides general course background in the biological sciences.

Course requirements involve 53 semester hours including:

<i>Biology core requirements</i> .....	36
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 General Botany and Ecology .....	5
BIO-2800 Introduction to Research Methods .....	2
BIO-3300 Genetics .....	4
BIO-3710 Biochemistry .....	4
BIO-4800 Senior Seminar–Biology .....	1
Biology electives .....	10
<i>Departmental requirements</i> .....	17
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510 Organic Chemistry I .....	5
GMTH-1030 Precalculus .....	4

#### Biology Major (B.A.) Curriculum Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	42-50
Biology Major Requirements .....	53
Electives .....	25-33
<b>Total (minimum not including proficiency)</b> .....	<b>128</b>

Students preparing for medicine, dentistry, osteopathy, or any of the **health professions** should refer to page 170 for a list of courses generally required by the professional colleges.

Students anticipating **graduate study** in biology should consider completing the bachelor of science in biology curriculum.



Students interested in environmental biology will benefit through interaction with Professor of Biology, Dr. John Silvius.

A complete description of the General Education Requirements is found on page 18

#### Suggested Four-Year Curriculum for a Major in Biology - B.A.

##### First year:

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
CHEM-1110, 1120 General Chemistry I, II .....	8
ENG-1400 Composition .....	3
GMTH-1030 Precalculus .....	4
PEF-1990 Physical Activity and the Christian Life .....	1
<b>Total</b> .....	<b>32</b>

##### Second year:

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-2130 General Botany and Ecology .....	5
BIO-2800 Introduction to Research Methods .....	2
BIO-3300 Genetics .....	4
CHEM-3510 Organic Chemistry I .....	5
COM-1100 Fundamentals of Speech .....	3
GSS-1000 Foundations of Social Science .....	3
HUM-1400 Introduction to the Humanities .....	3
Physical Education Activity Elective .....	1
<b>Total</b> .....	<b>32</b>

##### Third year:

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-3710 Biochemistry .....	4
Biology Electives .....	8
Humanities Elective .....	3
Literature Elective .....	3
Electives .....	10
<b>Total</b> .....	<b>32</b>

##### Fourth year:

BIO-4800 Senior Seminar–Biology .....	1
Biology Elective .....	3
History Elective .....	3
Social Science/Global Awareness Elective .....	3
Electives .....	22
<b>Total</b> .....	<b>32</b>

## Biology - Bachelor of Science

The **bachelor of science degree with a major in biology** prepares students for graduate study in the biological sciences by including the course requirements prescribed by many of the leading graduate-level biology degree programs in the nation. This major enhances the student's depth of knowledge in biology and increases the breadth of exposure to chemistry, mathematics, and physics.

Course requirements involve 80 hours including:

<i>Biology requirements</i> .....	44
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 General Botany and Ecology .....	5
BIO-2800 Introduction to Research Methods .....	2
BIO-3300 Genetics .....	4
BIO-3710 Biochemistry .....	4
BIO-3800 Biological Research .....	2
BIO-4800 Senior Seminar–Biology .....	1
Biology electives .....	16
<i>Departmental requirements</i> .....	36
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510, 3520 Organic Chemistry I, II .....	10
MATH-1710, 1720 Calculus I, II .....	10
PHYS-2110, 2120 General Physics I, II .....	8

### Biology Major (B.S.) Curriculum Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	42
Biology Major Requirements .....	80
Electives .....	6
<b>Total (minimum not including proficiency) .....</b>	<b>128</b>

Students interested in careers in **environmental biology** should refer to page 169 for the requirements of that special program.

Students preparing for medicine, dentistry, osteopathy, or any of the **health professions** should refer to page 170 for a list of courses generally required by professional colleges.



*Professors lead students to a greater depth of knowledge and understanding of God's creation.*

A complete description of the General Education Requirements is found on page 18

### Suggested Four-Year Curriculum for a Major in Biology - B.S.

#### First year:

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
CHEM-1110, 1120 General Chemistry I, II .....	8
COM-1100 Fundamentals of Speech .....	3
ENG-1400 Composition .....	3
PEF-1990 Physical Activity and the Christian Life .....	1
Physical Education Activity Elective .....	1
<b>Total .....</b>	<b>32</b>

#### Second year:

BIO-2130 General Botany and Ecology .....	5
BIO-2800 Introduction to Research Methods .....	2
BIO-3300 Genetics .....	4
CHEM-3510, 3520 Organic Chemistry I, II .....	10
MATH-1710, 1720 Calculus I, II .....	10
<b>Total .....</b>	<b>31</b>

#### Third year:

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-3710 Biochemistry .....	4
BIO-3800 Biological Research .....	2
GSS-1000 Foundations of Social Science .....	3
HUM-1400 Introduction to the Humanities .....	3
PHYS-2110, 2120 General Physics I, II .....	8
Literature Elective .....	3
Biology Electives .....	4
<b>Total .....</b>	<b>33</b>

#### Fourth year:

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-4800 Senior Seminar–Biology .....	1
Biology Electives .....	12
History Elective .....	3
Humanities Elective .....	3
Social Science/Global Awareness Elective .....	3
Electives .....	6
<b>Total .....</b>	<b>32</b>

# Science and Mathematics

## School of Engineering, Nursing, and Science

A complete description of the General Education Requirements is found on page 18

### Chemistry - Bachelor of Arts

The **bachelor of arts degree with a major in chemistry** prepares students for careers in the health professions, technical business professions, and other science related vocations.

Course requirements involve 52.5 semester hours including:

<i>Chemistry requirements</i> .....	31
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-2210 Analytical Chemistry I .....	3
CHEM-2800 Introduction to Research in Chemistry .....	1
CHEM-3510, 3520 Organic Chemistry I, II .....	10
CHEM-4310 Physical Chemistry I .....	4
CHEM-4800 Senior Seminar–Chemistry .....	1
Chemistry electives .....	4
<i>Departmental Requirements</i> .....	21.5
MATH-1710, 1720 Calculus I, II .....	10
PHYS-2110, 2120 General Physics I, II .....	8
BIO-1000 Principles of Biology .....	3.5
(or BIO-1110 Introduction to Cell Biology .....	5)

#### Chemistry Major Curriculum (B.A.) Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	42-50
Chemistry Major Requirements .....	52.5
Electives .....	25.5-34
<b>Total (minimum not including proficiency) .....</b>	<b>128</b>

Students anticipating **graduate study** should consider completing the bachelor of science in chemistry curriculum.

Students preparing for medicine, dentistry, osteopathy, or any of the **health professions** should refer to page 170 for a list of courses generally required by professional colleges.



Well-equipped chemistry labs enhance the student's ability to interpret laboratory findings and data.

#### Suggested Four-Year Curriculum for a Major in Chemistry – B.A.

<i>First year:</i>	
BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
CHEM-1110, 1120 General Chemistry I, II .....	8
COM-1100 Fundamentals of Speech .....	3
ENG-1400 Composition .....	3
MATH-1710, 1720 Calculus I, II .....	10
PEF-1990 Physical Activity and the Christian Life .....	1
Physical Education Activity Elective .....	1
<b>Total .....</b>	<b>32</b>

<i>Second year:</i>	
BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
CHEM-2210 Analytical Chemistry I .....	3
CHEM-2800 Introduction to Research in Chemistry .....	1
GSS-1000 Foundations of Social Science .....	3
HUM-1400 Introduction to the Humanities .....	3
PHYS-2110, 2120 General Physics I, II .....	8
Literature Elective .....	3
Electives .....	5
<b>Total .....</b>	<b>32</b>

<i>Third year:</i>	
BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-1000 Principles of Biology .....	3.5
CHEM-3510, 3520 Organic Chemistry I, II .....	10
CHEM-4310 Physical Chemistry I .....	4
Humanities Elective .....	3
Social Science/Global Awareness Elective .....	3
Electives .....	5
<b>Total .....</b>	<b>32.5</b>

<i>Fourth year:</i>	
CHEM-4800 Senior Seminar–Chemistry .....	1
Chemistry Electives .....	4
History Elective .....	3
Electives .....	24
<b>Total .....</b>	<b>32</b>

## Chemistry - Bachelor of Science

The **bachelor of science degree with a major in chemistry** prepares students for graduate study in chemistry and for careers in industry or research. The degree requirements provide training in each of the primary areas of chemistry with the necessary support in mathematics, physics, and biology.

Course requirements involve 68.5 semester hours including:

<i>Chemistry requirements</i> .....	47
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-2210, 2220 Analytical Chemistry I, II .....	6
CHEM-2800 Introduction to Research in Chemistry .....	1
CHEM-3510, 3520 Organic Chemistry I, II .....	10
CHEM-3410 Inorganic Chemistry .....	3
CHEM-4310, 4320 Physical Chemistry I, II .....	8
CHEM-4800 Senior Seminar–Chemistry .....	1
Chemistry electives .....	7
Departmental Elective .....	3
<i>Departmental Requirements</i> .....	21.5
MATH-1710, 1720 Calculus I, II .....	10
PHYS-2110, 2120 General Physics I, II .....	8
BIO-1000 Principles of Biology .....	3.5
(or BIO-1110 Introduction to Cell Biology .....	5)

### Chemistry Major (B.S.) Curriculum Summary:

Proficiency Requirements .....	0-5
Other General Education Requirements .....	42
Chemistry Major Requirements .....	68.5
Electives .....	17.5-18
<b>Total (minimum not including proficiencies) .....</b>	<b>128</b>



*Extensive opportunities for laboratory research enable students to develop important skills for a successful future.*

A complete description of the General Education Requirements is found on page 18

### Suggested Four-Year Curriculum for a Major in Chemistry – B.S.

*First year:*

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
CHEM-1110, 1120 General Chemistry I, II .....	8
COM-1100 Fundamentals of Speech .....	3
ENG-1400 Composition .....	3
MATH-1710, 1720 Calculus I, II .....	10
PEF-1990 Physical Activity and the Christian Life .....	1
Physical Education Activity Elective .....	1
<b>Total .....</b>	<b>32</b>

*Second year:*

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-1000 Principles of Biology .....	3.5
CHEM-2210, 2220 Analytical Chemistry I, II .....	6
CHEM-2800 Introduction to Research in Chemistry .....	1
GSS-1000 Foundations of Social Science .....	3
HUM-1400 Introduction to the Humanities .....	3
PHYS-2110, 2120 General Physics I, II .....	8
Literature Elective .....	3
<b>Total .....</b>	<b>33.5</b>

*Third year:*

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
CHEM-3510, 3520 Organic Chemistry I, II .....	10
CHEM-4310, 4320 Physical Chemistry I, II .....	8
History Elective .....	3
Social Science/Global Awareness Elective .....	3
Electives .....	4
<b>Total .....</b>	<b>32</b>

*Fourth year:*

CHEM-3410 Inorganic Chemistry .....	3
CHEM-4800 Senior Seminar–Chemistry .....	1
Chemistry Electives .....	7
Department Elective .....	3
Humanities Elective .....	3
Electives .....	14
<b>Total .....</b>	<b>31</b>

# Science and Mathematics

## School of Engineering, Nursing, and Science

### Computer Science – Bachelor of Science

The **computer science major** provides coursework and training in computer science. Patterned closely after the curriculum model proposed by the Computer Science Accreditation Board, this major prepares students for careers as software engineers, software programmers, and computer scientists.

Course requirements involve 73.5 semester hours including:

<i>Computer Science core requirements</i> .....	<b>39</b>
CS-1210 C++ programming .....	2
CS-1220 Object-Oriented Design using C++ .....	3
CS-2210 Data Structures Using Java .....	3
CS-3210 Programming Language Survey .....	3
CS-3310 Operating Systems .....	3
CS-3410 Algorithms .....	3
CS-3510 Compiler Theory and Practice .....	3
CS-4810,4820 Software Engineering I, II .....	7
EGCP-1010 Digital Logic Design .....	3
EGCP-2110 Microprocessors .....	3
ECCN-3110 Professional Ethics .....	3
MIS-3100 Database Development .....	3
<i>Technical Electives chosen from the following:</i> .....	<b>4</b>
Any 3000- or 4000-level computer science course	
EGCP-3010 Advanced Digital Logic Design .....	3
EGCP-3210 Computer Architecture .....	3
EGME-2050 Computational Methods .....	4
MATH-3610 Linear Algebra .....	3
MIS-3000 Systems Analysis and Design .....	3
MIS-3400 Data Communications and Networking .....	3
MIS-4200 Advanced Topics: Programming Languages ...	3
<i>Mathematics and Science Requirements</i> .....	<b>30.5</b>
CHEM-1050 Chemistry for Engineers .....	3.5
MATH-1710,1720 Calculus I, II .....	10
MATH-2210 Logic and Methods of Proof .....	3
MATH-3110 Probability and Statistics I .....	3
MATH-3550 Discrete Mathematics: Graph Theory .....	3
PHYS-2110, 2120 General Physics I, II .....	8

#### Computer Science Major (B.S.) Curriculum Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	42.5
Computer Science Major Requirements .....	73.5
Electives .....	12
<b>Total (minimum not including proficiency) .....</b>	<b>128</b>

A complete description of the General Education Requirements is found on page 18

#### Suggested Four-Year Curriculum for a Major in Chemistry – B.S.

##### First year:

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
CS-1210 C++ Programming .....	2
CS-1220 Object Oriented Design Using C++ .....	3
EGCP-1010 Digital Logic Design .....	3
ENG-1400 Composition .....	3
GSS-1000 Foundations of Social Science .....	3
MATH-1710, 1720 Calculus I, II .....	10
PEF-1990 Physical Activity and the Christian Life .....	1
Physical Education Activity Elective .....	1
<b>Total .....</b>	<b>32</b>

##### Second year:

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
CHEM-1050 Chemistry for Engineers .....	3.5
COM-1100 Fundamentals of Speech .....	3
CS-2210 Data Structures Using Java .....	3
CS-3210 Programming Language Survey .....	3
HUM-1400 Introduction to the Humanities .....	3
MATH-2210 Logic and Methods of Proof .....	3
PHYS-2110, 2120 General Physics I, II .....	8
<b>Total .....</b>	<b>32.5</b>

##### Third year:

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-1000 Principles of Biology .....	3.5
CS-3310 Operating Systems .....	3
CS-3410 Algorithms .....	3
CS-3510 Compiler Theory and Practice .....	3
EGCP-2110 Microprocessors .....	3
MATH-3110 Probability and Statistics I .....	3
MIS-3100 Database Development .....	3
History Elective .....	3
Literature Elective .....	3
<b>Total .....</b>	<b>31.5</b>

##### Fourth year:

CS-4810, 4820 Software Engineering I, II .....	7
CS Technical Elective .....	4
ECCN-3110 Professional Ethics .....	3
MATH-3550 Discrete Mathematics: Graph Theory .....	3
Social Science/Global Awareness Elective .....	3
Electives .....	12
<b>Total .....</b>	<b>32</b>

A complete description of the General Education Requirements is found on page 18

## Adolescent and Young Adult Licensure Programs

The Department of Science and Mathematics joins with the Department of Education to offer adolescent/young adult licensure programs in the following areas:

- Integrated Life Science
- Integrated Mathematics
- Integrated Physical Science
- Integrated Physics
- Integrated Science (comprehensive)

The course requirements for each licensure field are outlined under each major. However, the following courses are common to all adolescent/young adult majors in this department:

<i>Teacher Education</i> .....	39
COM-2300 Voices of Diversity .....	3
EDSE-4000 Reading in the Content Area: AYA .....	3
EDSE-4100 Principles of Teaching .....	5
EDSE-4450 Adol/Young Adult Clinical Experience .....	3
EDSE-4900 Student Teaching and Seminar: AYA .....	10-12
EDSP-2000 Teaching Children with Exceptionalities .....	2
EDSP-2050 Special Education Field Experience .....	1
EDSP-4000 Principles of Inclusion .....	1
EDUC-1000 The Education Profession .....	1
EDUC-1050 Contemporary Christian Schools .....	0
EDUC-2000 Introduction to Teaching .....	2
EDUC-2100 Technology in the Classroom .....	2
EDUC-2200 Multicultural Field Experience .....	1
EDUC-2500 Educational Psychology .....	3
EDUC-4500 Philosophy of Education .....	2

Specific information regarding admission to the Teacher Education Program and course descriptions are located in the Department of Education section in this catalog.

## Integrated Life Science Education–Bachelor of Arts

Course requirements involve 60.5 semester hours including:

<i>Biology Core Requirements</i> .....	28
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 General Botany and Ecology .....	5
BIO-2800 Introduction to Research Methods .....	2
BIO-3300 Genetics .....	4
BIO-4800 Senior Seminar–Biology .....	1
<i>Biology Electives chosen from following:</i> .....	6
BIO-3410 Invertebrate Zoology .....	3
BIO-3450 Human Structure and Function I .....	3
BIO-3460 Human Structure and Function II .....	3
BIO-3510 Plant Physiology .....	3
BIO-3520 Plant Taxonomy .....	3
BIO-3610 Environmental Physiology and Ecology .....	4
BIO-4300 Molecular Biology of the Cell .....	4
BIOA-3600 Topics in Environmental Biology .....	4
<i>Physical Science/Mathematics/Science Methods</i> .....	32.5
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510 Organic Chemistry I .....	5
CHEM-3710 Biochemistry .....	4
GSCI-1010 Principles of Earth Science .....	3.5
GMTH-1030 Precalculus .....	4
PHYS-1010 College Physics I .....	5
SCED-3110 Clinical Teaching in Science .....	1
SCED-3120 Teaching Science .....	2
<i>Teacher Education</i> .....	39

### Suggested Four-Year Curriculum for a Major in Integrated Life Science–B.A.

<i>First Year</i>	
BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
CHEM-1110, 1120 General Chemistry I, II .....	8
EDUC-1000 Education Profession .....	1
EDUC-1050 Contemporary Christian Schools .....	0
ENG-1400 Composition .....	3
GMTH-1030 Precalculus .....	4
PEF-1990 Physical Activity and the Christian Life .....	1
Physical Education Activity Elective .....	1
<b>Total</b> .....	<b>34</b>

<i>Second Year</i>	
BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-2130 General Botany and Ecology .....	5
BIO-2800 Introduction to Research Methods .....	2
CHEM-3510 Organic Chemistry I .....	5
COM-1100 Fundamentals of Speech .....	3
EDSP-2000 Teaching Children with Exceptionalities .....	2
EDSP-2050 Special Education Field Experience .....	1
EDUC-2000 Introduction to Teaching .....	2
EDUC-2100 Technology in the Classroom .....	2
EDUC-2200 Multicultural Field Experience .....	1
EDUC-2500 Educational Psychology .....	3
GSS-1000 Foundations of Social Science .....	3
HUM-1400 Introduction to the Humanities .....	3
<b>Total</b> .....	<b>38</b>

<i>Third Year</i>	
BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-3300 Genetics .....	4
CHEM-3710 Biochemistry .....	4
GSCI-1010 Principles of Earth Science .....	3.5
PHYS-1010 College Physics I .....	5
SCED-3110 Clinical Teaching in Science .....	1
Biology Electives .....	6
Literature Elective .....	3
Social Science/Global Awareness Elective .....	3
<b>Total</b> .....	<b>33.5</b>

<i>Fourth Year</i>	
BIO-4800 Senior Seminar–Biology .....	1
COM-2300 Voices of Diversity .....	3
EDSE-4000 Reading in the Content Area: AYA .....	3
EDSE-4100 Principles of Teaching .....	5
EDSE-4450 Clinical Experience: AYA .....	3
EDSE-4900 Student Teaching .....	10-12
EDSP-4000 Principles of Inclusion .....	1
EDUC-4500 Philosophy of Education .....	2
SCED-3120 Teaching Science .....	2
History Elective .....	3
<b>Total</b> .....	<b>33-35</b>

### Integrated Life Science Education Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	39-47
Major Requirements .....	60.5
Teacher Education .....	39
<b>Total (minimum not including proficiency)</b> .....	<b>138.5</b>

# Science and Mathematics

## School of Engineering, Nursing, and Science

### Integrated Mathematics Education– Bachelor of Arts

Course requirements involve 48 semester hours including:

<i>Mathematics Core Requirements</i> .....	33
MATH-1710, 1720 Calculus I, II .....	10
MATH-2210 Logic and Methods of Proof .....	3
MATH-3050 Algebraic Structures for Secondary Education ..	3
MATH-3110 Probability and Statistics I .....	3
MATH-3800 Research Methods in Mathematics .....	1
MATH-4410 Euclidean and Non-Euclidean Geometries ...	3
MATH-4800 Capstone Experience in Mathematics .....	1
<i>One course from the following:</i> .....	3
MATH-3550 Discrete Mathematics: Graph Theory ....	3
MATH-3560 Discrete Mathematics: Combinatorics ...	3
<i>Electives from the following:</i> .....	6
MATH-2710 Calculus III .....	3
MATH-2740 Differential Equations .....	3
Any 3000- and 4000-level mathematics course	
<i>Physics/Computer/Math Methods</i> .....	15
PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
MTED-3110 Clinical Teaching in Mathematics .....	1
MTED-3120 Teaching Mathematics .....	1
<i>One course from the following:</i> .....	3
MATH-4880 Topics in Mathematics: Writing and	
Research using Computers .....	3
MIS-2000 Structured Programming .....	3
<i>Teacher Education</i> .....	39
<b>Integrated Mathematics Education Summary</b>	
Proficiency Requirements .....	0-5
Other General Education Requirements .....	42.5-50.5
Major Requirements .....	48
Professional Education Requirements .....	39
<b>Total (minimum not including proficiency) .....</b>	<b>129.5</b>



Dr. Edwin Braithwaite, Professor of Mathematics, has shared his love of math with Cedarville students since 1976.

A complete description of the General Education Requirements is found on page 18

### Suggested Four-Year Curriculum for a Major in Integrated Mathematics Education–B.A.

<i>First year:</i>	
BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
BIO-1000 Principles of Biology .....	3.5
COM-1100 Fundamentals of Speech .....	3
EDUC-1000 Education Profession .....	1
EDUC-1050 Contemporary Christian Schools .....	0
ENG-1400 Composition .....	3
HUM-1400 Introduction to the Humanities .....	3
MATH-1710, 1720 Calculus I, II .....	10
PEF-1990 Physical Activity and the Christian Life .....	1
History Elective .....	3
Physical Education Activity Elective .....	1
<b>Total .....</b>	<b>34.5</b>
<i>Second year:</i>	
BEGE-2730 Old Testament Literature .....	3
EDSP-2000 Teaching Children with Exceptionalities .....	2
EDSP-2050 Special Education Field Experience .....	1
EDUC-2000 Introduction to Teaching .....	2
EDUC-2100 Technology in the Classroom .....	2
EDUC-2200 Multicultural Field Experience .....	1
EDUC-2500 Educational Psychology .....	3
GSS-1000 Foundations of Social Science .....	3
MATH-2210 Logic and Methods of Proof .....	3
MATH-3800 Research Methods in Mathematics .....	1
PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
Literature Elective .....	3
<b>Total .....</b>	<b>34</b>
<i>Third Year:</i>	
BEGE-2740 New Testament Literature .....	3
BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
MATH-3050 Algebraic Structures for Secondary Education .....	3
MATH-3110 Probability and Statistics I .....	3
MATH-4410 Euclidean and Non-Euclidean Geometry .....	3
MTED-3110 Clinical Teaching in Mathematics .....	1
Discrete Mathematics Elective .....	3
Computer Elective .....	3
Mathematics Electives .....	6
Social Science/Global Awareness Elective .....	3
<b>Total .....</b>	<b>32</b>
<i>Fourth year:</i>	
COM-2300 Voices of Diversity .....	3
EDSE-4000 Reading in the Content Area: AYA .....	3
EDSE-4100 Principles of Teaching .....	5
EDSE-4450 Clinical Experience: AYA .....	3
EDSE-4900 Student Teaching and Seminar: AYA .....	10-12
EDSP-4000 Principles of Inclusion .....	1
EDUC-4500 Philosophy of Education .....	2
MATH-4800 Capstone Experience in Mathematics .....	1
MTED-3120 Teaching Mathematics .....	1
<b>Total .....</b>	<b>29-31</b>

A complete description of the General Education Requirements is found on page 18

## Integrated Physical Science Education–Bachelor of Arts

Course requirements involve 72 semester hours including:

<i>Integrated Physical Science Core</i> .....	67
BIO-1110 Introduction to Cell Biology .....	5
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510 Organic Chemistry I .....	5
CHEM-3710 Biochemistry .....	4
ESCI-1110 Introduction to Physical Geology .....	4
ESCI-1120 Historical Geology .....	4
ESCI-2310 Introduction to Oceanography .....	4
ESCI-2510 Introductory Astronomy .....	4
MATH-1710, 1720 Calculus I, II .....	10
MATH-2740 Differential Equations .....	3
PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
PHYS-3510 Modern Physics I .....	3
SCED-3110 Clinical Teaching in Science .....	1
SCED-3120 Teaching Science .....	2
<i>Physics Electives selected from:</i> .....	3
PHYS-3110 Intermediate Physics Lab .....	2
PHYS-3310 Theoretical Mechanics .....	3
PHYS-3350 Thermal Physics .....	3
PHYS-4110 Advanced Physics Lab .....	2
PHYS-4510 Modern Physics II .....	3
<i>Research Methods (choose one)</i> .....	1
CHEM-2800 Introduction to Research in Chemistry .....	1
PHYS-3800 Research Methods in Physics .....	1
<i>Senior Capstone Experience (choose one)</i> .....	1
CHEM-4800 Senior Seminar–Chemistry .....	1
PHYS-4800 Senior Seminar–Physics .....	1

*Teacher Education* ..... 39

### Integrated Physical Science Education Curriculum Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	39-47
Major Requirements .....	72
Teacher Education .....	39
<b>Total (minimum not including proficiency) .....</b>	<b>150</b>



*Students gain an understanding of scientific functions and principles through instructional field trips with professors.*

### Suggested Four-Year Semester Curriculum for the Major in Integrated Physical Science Education

*First year:*

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
CHEM-1110, 1120 General Chemistry I,II .....	8
COM-1100 Fundamentals of Speech .....	3
EDUC-1000 The Education Profession .....	1
EDUC-1050 Contemporary Christian Schools .....	0
ENG-1400 Composition .....	3
MATH-1710, 1720 Calculus I, II .....	10
PHYS-2110 General Physics I .....	4
PEF-1990 Physical Activity and the Christian Life .....	1
Physical Education Activity Elective .....	1
<b>Total</b> .....	<b>37</b>

*Second year:*

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-1110 Introduction to Cell Biology .....	5
CHEM-3510 Organic Chemistry I .....	5
EDSP-2000 Teaching Children with Exceptionalities .....	2
EDSP-2050 Special Education Field Experience .....	1
EDUC-2000 Introduction to Teaching .....	2
EDUC-2100 Technology in the Classroom .....	2
EDUC-2200 Multicultural Field Experience .....	1
EDUC-2500 Educational Psychology .....	3
ESCI-2310 Introduction to Oceanography .....	4
GSS-1000 Foundations of Social Science .....	3
MATH-2740 Differential Equations .....	3
PHYS-2120, 2130 General Physics II, III .....	6
<b>Total</b> .....	<b>43</b>

*Third Year:*

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
CHEM-3710 Biochemistry .....	4
ESCI-1110 Introduction to Physical Geology .....	4
ESCI-1120 Historical Geology .....	4
ESCI-2510 Introduction to Astronomy .....	4
HUM-1400 Introduction to the Humanities .....	3
PHYS-3510 Modern Physics I .....	3
PHYS-3800 Research Methods in Physics .....	1
(or CHEM-2800 Introduction to Research in Chemistry .....	1)
History Elective .....	3
Literature Elective .....	3
Social Science Elective .....	3
<b>Total</b> .....	<b>36</b>

*Fourth year:*

COM-2300 Voices of Diversity .....	3
EDSE-4000 Reading in the Content Area: AYA .....	3
EDSE-4100 Principles of Teaching .....	5
EDSE-4450 AYA Clinical Experience .....	3
EDSE-4900 Student Teaching: AYA .....	10-12
EDSP-4000 Principles of Inclusion .....	1
EDUC-4500 Philosophy of Education .....	2
PHYS-4800 Senior Seminar–Physics .....	1
(or CHEM-4800 Chemistry Senior Seminar .....	1)
SCED-3110 Clinical Teaching in Physics .....	1
SCED-3120 Teaching Science .....	2
Physics Elective .....	3
<b>Total</b> .....	<b>34-36</b>

# Science and Mathematics

## School of Engineering, Nursing, and Science

### Integrated Physics Education– Bachelor of Arts

Course requirements involve 68 semester hours including:

<i>Physics Core Requirements</i> .....	34
PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
PHYS-3110 Intermediate Physics Lab .....	2
PHYS-3310 Theoretical Mechanics .....	3
PHYS-3410 Electromagnetic Theory I .....	3
PHYS-3510 Modern Physics I .....	3
PHYS-3800 Research Methods in Physics .....	1
PHYS-4110 Advanced Physics Lab .....	2
PHYS-4800 Senior Seminar–Physics .....	1
<i>Physics Electives selected from:</i> .....	9
PHYS-3350 Thermal Physics .....	3
PHYS-4210 Mathematical Methods of Physics .....	3
PHYS-4410 Electromagnetic Theory II .....	3
PHYS-4450 Optics .....	3
PHYS-4510 Modern Physics II .....	3
PHYS-4880 Topics in Physics .....	1-3
<i>Departmental Requirements</i> .....	34
BIO-1000 Principles of Biology .....	3.5
CHEM-1110, 1120 General Chemistry I, II .....	8
GSCI-1010 Principles of Earth Science .....	3.5
MATH-1710, 1720, 2710 Calculus I, II, III .....	13
MATH-2740 Differential Equations .....	3
SCED-3110 Clinical Teaching in Science .....	1
SCED-3120 Teaching Science .....	2
 <i>Teacher Education</i> .....	 39
 <b>Integrated Physics Education Curriculum Summary</b>	
Proficiency Requirements .....	0-5
Other General Education Requirements .....	39-47
Major Requirements .....	68
Teacher Education .....	39
<b>Total (minimum not including proficiency)</b> .....	<b>146</b>



Modern laboratories with extensive equipment resources are invaluable tools in the learning process.

A complete description of the General Education Requirements is found on page 18

### Suggested Four-Year Semester Curriculum for the Major in Integrated Physics Education

<i>First Year:</i>	
BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
CHEM-1110, 1120 General Chemistry I, II .....	8
COM-1100 Fundamentals of Speech .....	3
EDUC-1000 The Education Profession .....	1
EDUC-1050 Contemporary Christian Schools .....	0
ENG-1400 Composition .....	3
MATH-1710, 1720 Calculus I, II .....	10
PEF-1990 Physical Activity and the Christian Life .....	1
PHYS-2110 General Physics I .....	4
Physical Education Activity Elective .....	1
<b>Total</b> .....	<b>37</b>
 <i>Second Year:</i>	
BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-1000 Principles of Biology .....	3.5
EDSP-2000 Teaching Children with Exceptionalities .....	2
EDSP-2050 Special Education Field Experience .....	1
EDUC-2000 Introduction to Teaching .....	2
EDUC-2100 Technology in the Classroom .....	2
EDUC-2200 Multicultural Field Experience .....	1
EDUC-2500 Educational Psychology .....	3
GSS-1000 Foundations of Social Science .....	3
MATH-2710 Calculus III .....	3
MATH-2740 Differential Equations .....	3
PHYS-2120, 2130 General Physics II, III .....	6
Physics Elective .....	3
<b>Total</b> .....	<b>38.5</b>
 <i>Third Year:</i>	
BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
GSCI-1010 Principles of Earth Science .....	3.5
HUM-1400 Introduction to the Humanities .....	3
PHYS-3110 Intermediate Physics Laboratory .....	2
PHYS-3310 Theoretical Mechanics .....	3
PHYS-3510 Modern Physics I .....	3
PHYS-3800 Research Methods in Physics .....	1
Physics Electives .....	6
History Elective .....	3
Literature Elective .....	3
Social Science/Global Awareness Elective .....	3
<b>Total</b> .....	<b>34.5</b>
 <i>Fourth Year:</i>	
COM-2300 Voices of Diversity .....	3
EDSE-4000 Reading in the Content Area: AYA .....	3
EDSE-4100 Principles of Teaching .....	5
EDSE-4450 Adolescent/Young Adult Clinical Experience .....	3
EDSE-4900 Student Teaching: AYA .....	10-12
EDSP-4000 Principles of Inclusion .....	1
EDUC-4500 Philosophy of Education .....	2
PHYS-3410 Electromagnetic Theory I .....	3
PHYS-4110 Advanced Physics Laboratory .....	2
PHYS-4800 Senior Seminar–Physics .....	1
SCED-3110 Clinical Teaching in Physics .....	1
SCED-3120 Teaching Science .....	2
<b>Total</b> .....	<b>36-38</b>

## Integrated Science Education– Bachelor of Arts

Course requirements involve 73 semester hours including:

<i>Biology Core</i> .....	22
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 General Botany and Ecology .....	5
BIO-3300 Genetics .....	4
<i>One Biology Elective chosen from the following:</i> .....	3
BIO-3410 Invertebrate Zoology .....	3
BIO-3450 Human Structure and Function I .....	3
BIO-3510 Plant Physiology .....	3
BIO-3520 Plant Taxonomy .....	3
BIO-3610 Environmental Physiology and Ecology .....	4
BIO-4300 Molecular Biology of the Cell .....	4
BIOA-3600 Topics in Environmental Biology .....	4
<i>Physical Science/Mathematics/Science Methods</i> .....	51
BIO-4800 Senior Seminar–Biology .....	1
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510 Organic Chemistry I .....	5
CHEM-3710 Biochemistry .....	4
CHEM-2210 Analytical Chemistry I .....	3
(or CHEM-3520 Organic Chemistry II .....	5)
ESCI-1110 Introduction to Physical Geology .....	4
ESCI-2510 Introductory Astronomy .....	4
ESCI-1120 Historical Geology .....	4
(or ESCI-2310 Introduction to Oceanography .....	4)
(or ESCI-2410 General Meteorology .....	4)
PHYS-1010, 1020 College Physics I, II .....	10
GMTH-1030 Precalculus .....	4
CHEM-2800 Introduction to Research in Chemistry .....	1
(or BIO-2800 Introduction to Research Methods .....	2)
SCED-3110 Clinical Teaching in Science .....	1
SCED-3120 Teaching Science .....	2
<i>Teacher Education</i> .....	39

### Integrated Science Education Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	39-47
Major Requirements .....	73
Professional Education Requirements .....	39
<b>Total (minimum not including proficiency) .....</b>	<b>151</b>



The modern Engineering, Nursing, Science Center provides an excellent facility to enhance the student's ability for gaining knowledge of the sciences and mathematics.

A complete description of the General Education Requirements is found on page 18

### Suggested Four-Year Curriculum for a Major in Integrated Science–B.A.

<i>First Year</i>	
BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
CHEM-1110, 1120 General Chemistry I, II .....	8
EDUC-1000 The Education Profession .....	1
EDUC-1050 Contemporary Christian Schools .....	0
ENG-1400 Composition .....	3
ESCI-1010 Introduction to Physical Geology .....	4
GMTH-1030 Precalculus .....	4
PEF-1990 Physical Activity and the Christian Life .....	1
Physical Education Activity Elective .....	1
<b>Total .....</b>	<b>38</b>
<i>Second Year</i>	
BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-2130 General Botany and Ecology .....	5
BIO-2800 Introduction to Research Methods .....	2
(or CHEM-2800 Introduction to Research in Chemistry .....	1)
CHEM-3510 Organic Chemistry I .....	5
CHEM-2210 Analytical Chemistry I .....	3
(or CHEM-3520 Organic Chemistry II .....	5)
COM-1100 Fundamentals of Speech .....	3
EDSP-2000 Teaching Children with Exceptionalities .....	2
EDSP-2050 Special Education Field Experience .....	1
EDUC-2000 Introduction to Teaching .....	2
EDUC-2100 Technology in the Classroom .....	2
EDUC-2200 Multicultural Field Experience .....	1
EDUC-2500 Educational Psychology .....	3
GSS-1000 Foundations of Social Science .....	3
<b>Total .....</b>	<b>37-40</b>
<i>Third Year</i>	
BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-3300 Genetics .....	4
CHEM-3710 Biochemistry .....	4
ESCI-2510 Introductory Astronomy .....	4
ESCI-XXXX Earth Science Elective .....	4
HUM-1400 Introduction to the Humanities .....	3
PHYS-1010, 1020 College Physics I, II .....	10
SCED-3110 Clinical Teaching in Science .....	1
Biological Science Elective .....	3
Literature Elective .....	3
<b>Total .....</b>	<b>40</b>
<i>Fourth Year</i>	
BIO-4800 Senior Seminar–Biology .....	1
COM-2300 Voices of Diversity .....	3
EDSE-4000 Reading in the Content Area: AYA .....	3
EDSE-4100 Principles of Teaching .....	5
EDSE-4450 Adolescent/Young Adult Clinical Experience .....	3
EDSE-4900 Student Teaching: AYA .....	10-12
EDSP-4000 Principles of Inclusion .....	1
EDUC-4500 Philosophy of Education .....	2
SCED-3120 Teaching Science .....	2
History Elective .....	3
Social Science/Global Awareness Elective .....	3
<b>Total .....</b>	<b>36-38</b>

# Science and Mathematics

## School of Engineering, Nursing, and Science

### Mathematics - Bachelor of Arts

The **bachelor of arts degree with a major in mathematics** provides coursework and training in advanced mathematics. Because of the general nature of this curriculum and opportunity to complement the major with electives from other fields of study, this curriculum provides excellent preparation for graduate study in areas that require good quantitative and/or analytical skills such as philosophy, business, and theology. This liberal arts major also prepares students for a wide variety of career opportunities that require a general bachelor of arts degree. The flexibility of this major enables students to select their mathematics and other electives to meet educational or career goals.

Students should include courses in astronomy, chemistry, and physics as general electives.

Course requirements involve 43 semester hours including:

<i>Mathematics core requirements</i> .....	<b>31</b>
MATH-1710, 1720, 2710 Calculus I, II, III .....	13
MATH-2210 Logic and Methods of Proof .....	3
MATH-2740 Differential Equations .....	3
(or MATH-4410 Euclidean and Non-Euclidean Geometry 3)	
MATH-3800 Research Methods in Mathematics .....	1
MATH-4800 Capstone Experience in Mathematics .....	1
PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
<i>Electives</i> .....	<b>12</b>

(selected from MATH-3000 and MATH-4000 level courses including at least one course from each of the following sets)

*Set I:*

MATH-3110 Probability and Statistics I .....	3
MATH-3550 Discrete Mathematics: Graph Theory .....	3
MATH-3560 Discrete Mathematics: Combinatorics .....	3

*Set II:*

MATH-3500 Number Theory .....	3
MATH-3610 Linear Algebra .....	3
MATH-4610 Abstract Algebra I .....	3

*Set III:*

MATH-3740 Complex Variables .....	3
MATH-4410 Euclidean and Non-Euclidean Geometry .....	3
MATH-4450 Topology .....	3
MATH-4710 Real Variables I .....	3

#### Mathematics Major (B.A.) Curriculum Summary

Proficiency requirements .....	0-5
Other General Education Requirements .....	45.5-53.5
Mathematics major requirements .....	43
Electives .....	31.5-39.5
<b>Total (minimum not including proficiency) .....</b>	<b>128</b>

A complete description of the General Education Requirements is found on page 18

#### Suggested Four-Year Curriculum for a Major in Mathematics - B.A.

##### First year:

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
COM-1100 Fundamentals of Speech .....	3
ENG-1400 Composition .....	3
HUM-1400 Introduction to the Humanities .....	3
MATH-1710, 1720 Calculus I, II .....	10
MATH-2210 Logic and Methods of Proof .....	3
PEF-1990 Physical Activity and the Christian Life .....	1
History Elective .....	3
Physical Education Activity Elective .....	1
<b>Total .....</b>	<b>33</b>

##### Second year:

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
GSS-1000 Foundations of Social Science .....	3
MATH-2710 Calculus III .....	3
MATH-2740 Differential Equations .....	3
(or MATH-4410 Euclidean and Non-Euclidean Geometry .....	3)
MATH-3800 Research Methods in Mathematics .....	1
PHYS-2110, 2120 General Physics I, II .....	8
Literature Elective .....	3
Electives .....	6
<b>Total .....</b>	<b>33</b>

##### Third year:

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-1000 Principles of Biology .....	3.5
PHYS-2130 General Physics III .....	2
Mathematics Electives .....	6
Humanities Elective .....	3
Social Science/Global Awareness Elective .....	3
Electives .....	12
<b>Total .....</b>	<b>33.5</b>

##### Fourth year:

MATH-4800 Capstone Experience in Mathematics .....	1
Mathematics Electives .....	6
Electives .....	22
<b>Total .....</b>	<b>29</b>

## Mathematics - Bachelor of Science

The **bachelor of science degree with a major in mathematics** prepares students for graduate study in mathematics. The curriculum includes the course requirements prescribed by many of the leading graduate-level mathematics programs in the nation.

Students should include courses in astronomy, chemistry, and physics as general electives. Course requirements involve 52 hours:

<i>Mathematics core requirements</i> .....	<b>31</b>
MATH-1710, 1720, 2710 Calculus I, II, III .....	13
MATH-2210 Logic and Methods of Proof .....	3
MATH-2740 Differential Equations .....	3
(or MATH-4410 Euclidean and Non-Euclidean Geometry 3)	
MATH-3800 Research Methods in Mathematics .....	1
MATH-4800 Capstone Experience in Mathematics .....	1
PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
<i>Electives (meeting the following criteria)</i> .....	<b>21</b>

A. At least one course from each of the following sets must be included:

Set I:

MATH-3110 Probability and Statistics I .....	3
MATH-3550 Discrete Mathematics: Graph Theory .....	3
MATH-3560 Discrete Mathematics: Combinatorics .....	3

Set II:

MATH-3500 Number Theory .....	3
MATH-3610 Linear Algebra .....	3
MATH-4610 Abstract Algebra I .....	3

Set III:

MATH-3740 Complex Variables .....	3
MATH-4410 Euclidean and Non-Euclidean Geometry .....	3
MATH-4450 Topology .....	3
MATH-4710 Real Variables I .....	3

B. At least one of the six semester hour pairs:

Pair I:

MATH-3550 Discrete Mathematics: Graph Theory .....	3
MATH-3560 Discrete Mathematics: Combinatorics .....	3

Pair II:

MATH-3110 Probability and Statistics I .....	3
MATH-4110 Probability and Statistics II .....	3

Pair III:

MATH-4610 Abstract Algebra I .....	3
MATH-4620 Abstract Algebra II .....	3

Pair IV:

MATH-4710 Real Variables I .....	3
MATH-4720 Real Variables II .....	3

C. Additional 3000- and 4000- level MATH electives not already taken

### Mathematics Major (B.S.) Curriculum Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	45.5
Mathematics Major Requirements .....	52
Electives .....	31
<b>Total (minimum not including proficiency)</b> .....	<b>128</b>

A complete description of the General Education Requirements is found on page 18

### Suggested Four-Year Curriculum for a Major in Mathematics - B. S.

*First year:*

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
COM-1100 Fundamentals of Speech .....	3
ENG-1400 Composition .....	3
HUM-1400 Introduction to the Humanities .....	3
MATH-1710, 1720 Calculus I, II .....	10
MATH-2210 Logic and Methods of Proof .....	3
PEF-1990 Physical Activity and the Christian Life .....	1
History Elective .....	3
Physical Education Activity Elective .....	1
<b>Total</b> .....	<b>33</b>

*Second year:*

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
GSS-1000 Foundations of Social Science .....	3
MATH-2710 Calculus III .....	3
MATH-2740 Differential Equations .....	3
(or MATH-4410 Euclidean and Non-Euclidean Geometry .....	3)
MATH-3800 Research Methods in Mathematics .....	1
PHYS-2110, 2120 General Physics I, II .....	8
Literature Elective .....	3
Electives .....	6
<b>Total</b> .....	<b>33</b>

*Third year:*

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
BIO-1000 Principles of Biology .....	3.5
PHYS-2130 General Physics III .....	2
Mathematics Electives .....	9
Humanities Elective .....	3
Social Science/Global Awareness Elective .....	3
Electives .....	9
<b>Total</b> .....	<b>33.5</b>

*Fourth year:*

MATH-4800 Capstone Experience in Mathematics .....	1
Mathematics Electives .....	12
Electives .....	16
<b>Total</b> .....	<b>29</b>

# Science and Mathematics

## School of Engineering, Nursing, and Science

### Physics

The **physics major** prepares students for graduate study in physics or for employment opportunities in industry. The curriculum includes courses prescribed by leading graduate-level physics programs in the nation.

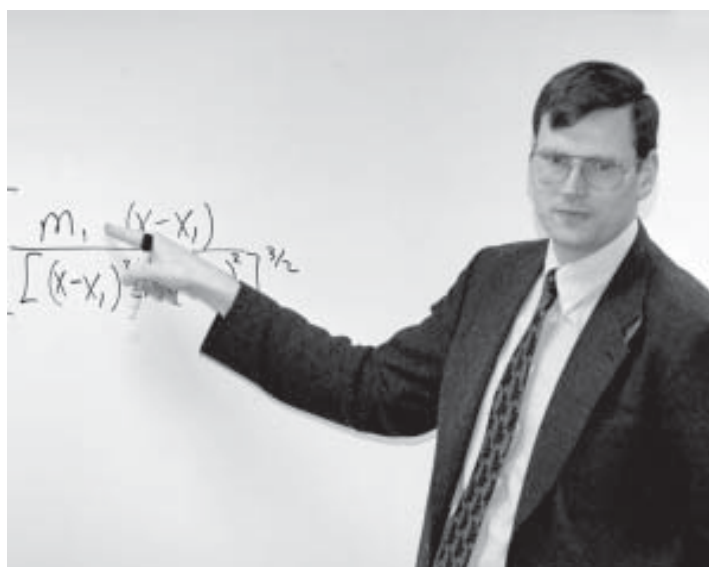
Students should include courses in mathematics and chemistry as general electives.

Course requirements involve 53.5 semester hours:

<i>Physics Core Requirements</i> .....	34
PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
PHYS-3110 Intermediate Physics Lab .....	2
PHYS-3310 Theoretical Mechanics .....	3
PHYS-3410 Electromagnetic Theory I .....	3
PHYS-3510 Modern Physics I .....	3
PHYS-3800 Research Methods in Physics .....	1
PHYS-4110 Advanced Physics Lab .....	2
PHYS-4800 Senior Seminar–Physics .....	1
<i>Physics Electives (3 courses) chosen from the following:</i> ..	9
PHYS-3350 Thermal Physics .....	3
PHYS-4210 Mathematical Methods of Physics .....	3
PHYS-4410 Electromagnetic Theory II .....	3
PHYS-4450 Optics .....	3
PHYS-4510 Modern Physics II .....	3
PHYS-4880 Topics in Physics .....	1-3
<i>Departmental Requirements</i> .....	19.5
CHEM-1050 Chemistry for Engineers .....	3.5
MATH-1710, 1720, 2710 Calculus I, II, III .....	13
MATH-2740 Differential Equations .....	3

#### Physics Major Curriculum Summary

Proficiency Requirements .....	0-5
Other General Education Requirements .....	45.5-53.5
Physics Major Requirements .....	53.5
Electives .....	21-29
<b>Total (minimum not including proficiency)</b> .....	<b>128</b>



Steven Gollmer, Professor of Physics, has offered expert teaching in the classroom since 1994.

A complete description of the General Education Requirements is found on page 18

#### Suggested Four-Year Curriculum for a Major in Physics

##### First year:

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
CHEM-1050 Chemistry for Engineers .....	3.5
COM-1100 Fundamentals of Speech .....	3
ENG-1400 Composition .....	3
MATH-1710, 1720 Calculus I, II .....	10
PEF-1990 Physical Activity and the Christian Life .....	1
PHYS-2110 General Physics I .....	4
Physical Education Activity Elective .....	1
<b>Total</b> .....	<b>31.5</b>

##### Second year:

BEGE-2730 Old Testament Literature .....	3
BEGE-2740 New Testament Literature .....	3
BIO-1000 Principles of Biology .....	3.5
GSS-1000 Foundations of Social Science .....	3
MATH-2710 Calculus III .....	3
MATH-2740 Differential Equations .....	3
PHYS-2120, 2130 General Physics II, III .....	6
PHYS-3310 Theoretical Mechanics .....	3
Elective .....	5
<b>Total</b> .....	<b>32.5</b>

##### Third year:

BEGE-3750 Christian Worldview Development .....	2
BEGE-3760 Christian Worldview Integration .....	2
HUM-1400 Introduction to the Humanities .....	3
PHYS-3110 Intermediate Physics Laboratory .....	2
PHYS-3410 Electromagnetic Theory I .....	3
PHYS-3800 Research Methods in Physics .....	1
Physics Electives .....	3
Literature Elective .....	3
Electives .....	12
<b>Total</b> .....	<b>31</b>

##### Fourth year:

PHYS-3510 Modern Physics I .....	3
PHYS-4110 Advanced Physics Laboratory .....	2
PHYS-4800 Senior Seminar–Physics .....	1
History Elective .....	3
Humanities Elective .....	3
Physics Electives .....	6
Social Science/Global Awareness Elective .....	3
Electives .....	12
<b>Total</b> .....	<b>33</b>

## Minors

The minors in the Department of Science and Mathematics are designed to provide non-majors with additional background in the biological sciences, mathematics, and physical sciences.

Course requirements for the **biology minor** involve 19 semester hours including:

BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 General Botany and Ecology .....	5
Biology Electives .....	4

Course requirements for the **chemistry minor** involve 19 semester hours including:

CHEM-1110,1120 General Chemistry I, II .....	8
CHEM-2210 Analytical Chemistry I .....	3
CHEM-3510 Organic Chemistry I .....	5
Chemistry Electives .....	3

Course requirements for the **earth science minor** involve 20 semester hours including:

ESCI-1110 Introduction to Physical Geology .....	4
ESCI-1120 Historical Geology .....	4
ESCI-2310 Introduction to Oceanography .....	4
ESCI-2410 General Meteorology .....	4
ESCI-2510 Introductory to Astronomy .....	4

Course requirements for the **mathematics minor** involve 19 semester hours including:

MATH-1710, 1720 Calculus I, II .....	10
Mathematics Electives selected from the following: .....	9
MATH-2210 Logic and Methods of Proof .....	3
MATH-2710 Calculus III .....	3
MATH-2740 Differential Equations .....	3
Any 3000- or 4000- level mathematics course	

Course requirements for the **physics minor** involve 16 semester hours selected from:

PHYS-2110, 2120, 2130 General Physics I, II, III .....	10
PHYS-3510 Modern Physics I .....	3
Physics Electives .....	3

Course requirements for the **computer science minor** involve 27 semester hours including:

CS-1210 C++ Programming .....	2
CS-1220 Object-Oriented Design Using C++ .....	3
CS-2210 Data Structures using Java .....	3
CS-3410 Algorithms .....	3
EGCP-1010 Digital Logic Design .....	3
MATH-1710, 1720 Calculus I, II .....	10
Electives (choose one from the following) .....	3
MATH-3110 Probability and Statistics I .....	3
EGEE-3370 Probability and Random Processes .....	3

## Special Programs

The **environmental biology curriculum** within the biology major provides undergraduate preparation for students who are pursuing careers in such fields as conservation biology, wildlife biology, environmental toxicology, and environmental health. In addition to formal courses in biology, chemistry, and mathematics, employment criteria for these professions include prior experience (e.g., as a summer employee or intern), field biology skills (i.e., plant/animal taxonomy, habitat assessment and improvement), interpersonal skills, mathematical and communication skills, and the ability to reason critically and integrate across disciplines.

Students in the environmental biology program must complete the requirements for the B.S. in biology, including 16 hours of electives chosen from the list below:

<i>*Electives selected from the following:</i> .....	16
BIO-2210 Microbiology .....	4
BIO-3410 Invertebrate Zoology .....	4
BIO-3420 Vertebrate Zoology .....	4
BIO-3510 Plant Physiology .....	3
BIO-3520 Plant Taxonomy .....	3
BIO-3610 Environmental Physiology and Ecology .....	4
BIOA-3600 Topics in Environmental Biology (Au Sable Institute Courses) .....	4-12
BIO-4910 Environmental Biology Internship .....	4
*12 of the 16 elective hours must be 3000-4000 level courses.	

Students pursuing *environmental education* (e.g. interpretive naturalist) may also elect to complete requirements for state teacher licensure through the university Department of Education. The environmental biology curriculum can also serve as a useful component for students who plan to serve in missions ministries through programs related to soil, water, and plant/animal resource management.



*Students learn to develop stewardship of God's creation through proper care and study in the laboratory.*

# Science and Mathematics

## School of Engineering, Nursing, and Science

The **preagriculture curriculum** is designed to satisfy the technical and nontechnical requirements of the first two years of a typical agriculture program. Students should research agricultural schools to which they wish to transfer at the junior level so that application materials can be completed in advance of deadlines. The preagriculture students should confer with their advisor to select electives based upon the following criteria:

- The requirements of the school to which they will transfer after leaving Cedarville University.
- The specific agricultural program they wish to enter.

Course requirements include core requirements and an emphasis in either agriculture business or agriculture science.

Core requirements include:

BEGE-1710 Christian Life and Thought .....	3
BEGE-1720 Spiritual Formation .....	3
BIO-1110 Introduction to Cell Biology .....	5
CHEM-1110 General Chemistry I .....	4
ENG-1400 Composition .....	3
GMTH-1030 Precalculus .....	4
(or MATH-1710 Calculus I .....	5)
GSS-1000 Foundations of Social Science .....	3
HUM-1400 Introduction to the Humanities .....	3

The *agriculture business emphasis* prepares students for careers in the industry and business phases of agriculture.

Course requirements include:

<i>Two courses (selected from):</i> .....	10
ACCT-2110 Principles of Accounting .....	3
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 Botany and Ecology .....	5
BIO-2210 Microbiology .....	4
BIO-3300 Genetics .....	4
BUS-2150 Statistics .....	3
ECON-2330, 2340 Micro and Macroeconomics .....	6
MGMT-3500 Principles of Organization and Management .....	3
MIS-1100 Introduction to Computers .....	1
Humanities Electives .....	6
Social Science Elective .....	3

The *agriculture science emphasis* prepares students for careers including agronomy, animal science, food science, and horticulture.

Course requirements include:

BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 General Botany and Ecology .....	5
CHEM-3510, 3520 Organic Chemistry I, II .....	10
MATH-1720 Calculus II .....	5
MATH-3110 Probability and Statistics I .....	3
Biological Science Elective .....	4
(or CHEM-3710 Biochemistry .....	4)
Humanities Elective .....	3
Social Science Elective .....	3

A **medical technology** option is available within the biology major. The student must spend one year in a hospital internship program to become a certified medical technologist. Prerequisites to the hospital internship include: 16 hours of biology, 16 hours of chemistry, one mathematics course, and completion of all General Education Requirements.

Students may do an internship during their senior year with 32 hours of transfer credit applied to the biology major upon

successful completion of the internship. Many students complete the requirements for a biology major first and then take the internship after graduation from Cedarville University.

### **Predental, Premedical, Preoptometric, Preosteopathic, and Preveterinary Medicine**

Cedarville University students have been successful in gaining admission to medical and professional schools. For many of these schools, no specific major is required; however, students typically choose majors in biology or chemistry. In addition to general degree requirements, the following courses are recommended for admission:

The following courses are usually required by the professional colleges:

*Biology courses:*

BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2210 Microbiology .....	4
BIO-3300 Genetics .....	4
BIO-3420 Vertebrate Zoology .....	4
(or BIO-4410 Vertebrate Embryology .....	4)
BIO-3450, 3460 Human Structure and Function I, II .....	6
BIO-4710 Principles of Bioethics .....	3
(or BIO-3770 Pathophysiology .....	3)

*Chemistry courses:*

CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510, 3520 Organic Chemistry I, II .....	10
CHEM-3710 Biochemistry .....	4

*Additional courses:*

MATH-1710, 1720 Calculus I, II .....	10
PHYS-1010, 1020 College Physics I, II .....	10

*Note: Students who desire admission to Physician Assistant programs will also need to have 1000 hours or more of direct health care experience. Specific requirements vary from one program to another.*

### **Prepharmacy**

The **prepharmacy curriculum** enables a student to obtain the first two or three years of the five- or six-year pharmacy program at Cedarville University. To ensure that specific course requirements may be met through Cedarville courses, the student should select the pharmacy college he or she plans to attend as early as possible and obtain a catalog describing the specific course requirements.

Generally the following courses should be included in the two or three years the prepharmacy student attends Cedarville:

BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-2130 Botany and Ecology .....	5
BIO-2210 Microbiology .....	4
BIO-3450 Human Structure and Function I .....	3
CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510, 3520 Organic Chemistry I, II .....	10
MATH-1710 Calculus I .....	5
PHYS-1010, 1020 College Physics I, II .....	10
COM-1100 Fundamentals of Speech .....	3
ENG-1400 Composition .....	3
GSS-1000 Foundations of Social Science .....	3
PYCH-1600 General Psychology .....	3

### Prephysical Therapy

Most Cedarville students who successfully apply to graduate programs in physical therapy have completed the B.A. in biology. Students should contact the specific schools they wish to attend to determine the exact prerequisites. Physical therapy schools usually require between 40 to 100 hours of experience assisting a licensed physical therapist prior to application. In addition to general degree requirements, the following courses are recommended for admission to most physical therapy schools:

#### *Biology courses:*

BIO-1110 Introduction to Cell Biology .....	5
BIO-1120 General Zoology and Population Dynamics .....	5
BIO-3300 Genetics .....	4
BIO-3450, 3460 Human Structure and Function I, II .....	6
BIO-3770 Pathophysiology .....	3
BIO-4710 Principles of Bioethics .....	3

#### *Chemistry courses:*

CHEM-1110, 1120 General Chemistry I, II .....	8
CHEM-3510 Organic Chemistry I .....	5
CHEM-3710 Biochemistry .....	4

#### *Additional mathematics and science courses:*

GMTH-1030 Precalculus .....	4
PHYS-1010, 1020 College Physics I, II .....	10

#### *Psychology:*

PYCH-1600 General Psychology .....	3
PYCH-2600 Human Development: Lifespan .....	3
PYCH-2610 Statistics .....	3
PYCH-2640 Psychology of Abnormal Behavior .....	3

#### *Other highly recommended electives include:*

ATRN-2650 Therapeutic Exercise for Athletic Injuries .....	2
ATRN-3660 Modalities in Athletic Training .....	3
ESS-3920 Biomechanics .....	3
ESS-3940 Structural Kinesiology .....	1
ESS-3900 Physiology of Exercise .....	3

## Course Descriptions

### **General Education**

Except where noted, general education courses are designed to meet the General Education Requirements for graduation. These courses will not count toward graduation requirements for majors found in the department of science and mathematics unless they are specifically listed in the curriculum requirements for a major. A student majoring in science or mathematics may take these courses only as electives. However, any course listed for science or mathematics major or minor may also count toward fulfilling General Education Requirements.

#### **BIO-1000 Principles of Biology–Fa,Sp,Su 3.5 hours**

Emphasizes basic life processes and the principles by which these processes operate at the ecological, organismic, and cellular levels of organization with emphasis on human responsibility toward life at all levels. Three lectures each week and one two-hour laboratory which meets every two weeks. (Fee: \$75)

#### **BIO-2010 Human Anatomy and Physiology–Fa 4 hours**

Survey of the principal systems of the human body with emphasis on both structure and function. Includes the skeletal, muscular, nervous, endocrine, cardiovascular, and respiratory systems. Three lectures and one two-hour laboratory per week. *Prerequisite:* BIO-1000 *Principles of Biology*; or CHEM-1000 *Principles of Chemistry*. (Fee: \$100)

#### **BIO-2020 Advanced Clinical Physiology–Sp 4 hours**

Advanced study in human structure and function, including the digestive, urinary, and reproductive systems, as well as metabolism and acid-base balance. The pathophysiology of

disease is presented using a case-study format. Three lectures and one two-hour laboratory per week. *Prerequisite:* BIO-2010 *Human Anatomy and Physiology*. (Fee: \$100)

#### **CHEM-1000 Principles of Chemistry–Fa 5 hours**

For non-science majors, an introduction to atomic structure, ionic and covalent bonding, stoichiometry, kinetic theory, solutions and equilibria, nuclear chemistry, nomenclature, structure, and reactions of organic compounds. Four lectures and one two-hour laboratory per week. (Fee: \$100)

#### **CHEM-1010 Principles of Biochemistry–Sp 5 hours**

For non-science majors, an introduction to organic compounds not covered in CHEM-1000, and a study of the nomenclature and metabolism of proteins, carbohydrates, lipids, and nucleic acids. Four lectures and one two-hour laboratory per week.

*Prerequisite:* CHEM-1000 *Principles of Chemistry*. (Fee: \$100)

#### **CHEM-1050 Chemistry for Engineers–Fa 3.5 hours**

Fundamental concepts of chemistry are developed with applications of chemistry to engineering disciplines. Students are introduced to measurement, number handling, the Periodic Table, descriptive properties of atoms, elements, molecules, and ions, chemical reactions, stoichiometry, chemical bonding, equilibrium, thermodynamics, gas laws, and the nature of solids and liquids. Laboratory emphasizes quantitative skills. Three lectures per week, one biweekly two-hour laboratory. (Fee: \$75)

#### **ESCI-1110 Principles of Physical Geology–Fa 4 hours**

An introductory study of the earth and its geological processes. Major lecture topics include minerals, rocks, fossils, weathering, plate tectonics, earth history, dating, streams, groundwater, glaciers, and various internal and surface features of the earth. Time will be spent in the discussion of various alternative interpretations of earth history. Laboratory exercises will complement the lecture material and will include field trips to various areas of local geological interest. Three weekly lectures and one weekly laboratory experience. This course satisfies the physical science requirement of the general education requirements. *No prerequisites* (Fee: \$100)

#### **ESCI-1120 Historical Geology–Sp 4 hours**

The earth's geological history from its beginning to the present will be reviewed from both conventional and non-conventional perspectives. Discussion will occur on the evidence and merits of conflicting viewpoints. Major lecture topics include a survey of the various eras of geological time, plate tectonics, biological evolution, the meaning of the fossil record, dating methods and correlation of rocks. Field trips will focus on local paleontology. Three lectures and one laboratory per week. This course satisfies the physical science requirement of the general education requirements. *Prerequisites:* GSCI-1030 *Principles of Earth Science*; ESCI-1110 *Principles of Physical Geology*; or *permission of instructor*. (Fee: \$100)

#### **ESCI-2310 Introduction to Oceanography–Fa 4 hours**

An introductory survey of the oceans and the processes that occur in and around them. Major topics of discussion will include ocean currents, coastlines, plate tectonics, marine sediments, waves, tides, composition of sea water, interaction of the ocean with the atmosphere, marine life forms and their habitats. A field trip will visit a local aquarium. Lecture 3 times per week, one laboratory per week. This course satisfies the physical science requirement of the general education requirements. *No prerequisites*. (Fee: \$100) (odd years)

#### **ESCI-2410 General Meteorology–Sp 4 hours**

A survey of basic meteorological principles and weather systems. Topics covered will include the vertical structure of the atmosphere, cloud development and precipitation, optical effects of the atmosphere, wind systems, air masses, fronts and severe weather. Labs will be used to develop basic meteorological skills such as observation of local weather, decoding and

# Science and Mathematics

## School of Engineering, Nursing, and Science

interpretation of meteorological data, and introductory weather forecasting. Three lectures and one two-hour laboratory per week. This course satisfies the physical science requirement of the general education requirements. *Prerequisite: high school physics; GMTH-1030 Precalculus or equivalent; or permission of instructor.* (Fee: \$100) (odd years)

### **ESCI-2510 Introduction to Astronomy–Sp 4 hours**

An introduction to the structure and composition of the universe. Topics covered will include measurement of celestial objects, structure of the solar system and galaxy, composition and history of the universe. Time will be spent in the discussion of various cosmological models and their implications. Three weekly lectures and one two-hour laboratory per week. Variations in the laboratory schedule will be made to accommodate field observations. This course satisfies the physical science requirement of the general education requirements. *Prerequisite: GMTH-1030 Precalculus or equivalent; or permission of instructor.* (Fee: \$100) (even years)

### **GMTH-1010 Introduction to Mathematics–Fa,Sp 3 hours**

Introduction to mathematical concepts including voting theory, apportionment and fair division, models of population growth, and graph theory. *Prerequisites: proficiency in mathematics.*

### **GMTH-1020 College Algebra–Fa 3 hours**

Introduction to methods of algebraic analysis. Includes, but may not be limited to, many topics of intermediate algebra: the field axioms, linear functions, inequalities, systems of equations, determinants, and quadratic functions. This course, in conjunction with GMTH-1030 Precalculus, is designed to prepare the student for calculus. *Prerequisite: two years of high school mathematics; or permission of instructor.*

### **GMTH-1030 Precalculus–Fa,Sp 4 hours**

Introduction to the principles of trigonometry and possibly some advanced topics in algebra. Coverage includes, but may not be limited to exponential, logarithmic, trigonometric and circular functions, triangle problems, and vectors. This course, in conjunction with GMTH-1020 College Algebra, is designed to help prepare the student for calculus. *Prerequisites: proficiency in mathematics and GMTH-1020 College Algebra or equivalent; or permission of instructor.*

### **GMTH-1040 Calculus for Business–Fa,Sp 3 hours**

Introduction to the concepts of differential and integral calculus for students of business. Numerous applications from these areas will be considered. Does not apply toward major in mathematics. *Prerequisite: proficiency in mathematics*

### **GMTH-3010 Proof and Mathematical Modeling–Sp 3 hours**

Proof by contradiction, contrapositive, and induction will be explored along with direct proof in the verification of conjectures and other mathematical propositions. Additionally, the formulation of discrete, statistical and algebraic mathematical models, along with their use in solving problems, will be studied. Appropriate educational technology, including graphing calculators, spreadsheets, and geometric manipulation software, will be used throughout. *Prerequisites: EDUC-1800 Principles of Mathematics I; EDUC-2800 Principles of Mathematics II; GMTH-1020 College Algebra; and MATH-1710 Calculus I.*

### **GSCI-1010 Principles of Earth Science–Fa,Sp 3.5 hours**

A survey of the sciences of geology, oceanography and meteorology. Major lecture topics include discussion of earth's geological history, minerals, rocks, dating, plate tectonics, glaciers, volcanoes, ocean currents, marine life, waves, the atmosphere, and weather systems. When appropriate, contrasting views of these subjects will be examined. Laboratory experiences will include field trips to areas of local geological interest. Lecture three times per week, laboratory on alternate weeks. This course satisfies the physical science requirement of

the general education requirements. (Fee: \$75)

### **GSCI-1020 Principles of Physical Science–Fa,Sp 3.5 hours**

A survey of the sciences of physics, chemistry and astronomy. Major lecture topics include motion, force, energy, heat, waves, electricity, optics, quantum effects, periodic table, chemical bonds, chemical reactions, astronomical measurements, and the origin of the universe. Content of this course will be related to social and philosophical issues to emphasize a Christian's responsibility in a technological society. Lecture three times per week, laboratory on alternate weeks. This course satisfies the physical science requirement of the general education requirements. (Fee: \$75)

### **GSCI-2010 Physical Science for Teachers–Fa,Sp 4 hours**

Introduction to a selection of core concepts of physics and chemistry for preservice elementary education teachers. Students will develop methods of learning science, with emphasis on inquiry, scientific method, and integrating common everyday objects and experiences with a view toward cultivating the excitement of studying the Creator's Creation. Three lectures with one weekly one-hour lab. Does not satisfy the physical science General Education Requirement. (Fee: \$75)

### **GSCI-2710 Ethics of Human Reproduction–Fa 3 hours**

A study of topics pertaining to human sexuality: biology of human reproduction, conception control, infanticide, abortion, sexually transmitted diseases, biblical standards of sexuality, and teaching biblical sexuality to children and teens.

*Prerequisites: BIO-1000 Principles of Biology; GSS-1000 Foundations of Social Science.*

### **GSCI-3010 Concepts in Middle School Science–Sp 4 hours**

This lab course highlights key concepts in middle school science by reviewing and extending concepts from previous science courses with an emphasis on the integration of earth sciences, physical sciences, and life sciences. Concepts addressed include the scientific process, theory of evolution, cell theory, and the concept of disease.

### **GSCI-3060 Environmental Science for Middle School Educators–Sp 4 hours**

Introduction to the study of the dynamic relationships that exist between the earth's organisms and their environment, and how man affects these relationships. This course will include laboratory investigations, field trips, group work, review of environmental news, lecture-discussions, videos, small projects and pertinent ideas for teaching the environment in a middle school setting. There will be an emphasis on the intricate design and resilience of God's creation. Three lectures and one laboratory session per week. This course does not satisfy the general education requirement for biology. *Prerequisites: BIO-1000 Principles of Biology; Middle childhood education major; or permission of instructor.* (Fee: \$100)

### **GSCI-4800 Seminar–Sp (2003 only) 1 hour**

Students present a paper from library or laboratory research. Each student must obtain approval of the topic from his/her advisor and seminar instructor before enrolling in the course. The students must attend a minimum of 10 seminars during the senior year. Guest lecturers and faculty members may present papers at the invitation of the instructor. Capstone course. *Prerequisite: senior status; and attendance of a minimum of 10 seminars during the sophomore and junior years.*

### **MTEd-3110 Clinical Teaching in Mathematics–Fa,Sp 1 hour**

Students are assigned to assist a college instructor in classroom and laboratory teaching, evaluation, and related responsibilities. The student must complete 40 clock hours of clinical involvement in each teaching field for which licensure is desired.

### **MTEd-3120 Teaching Mathematics–Fa 1 hour**

Designed to introduce prospective secondary school science teachers to the curriculum, materials, and methods of classroom teaching. *Prerequisite: admission to the teacher education program.*

# Science and Mathematics

## School of Engineering, Nursing, and Science

- PHYS-1010 College Physics I–Fa** **5 hours**  
Basic concepts of mechanics and thermodynamics. Topics include kinematics, motion in two dimensions, force and motion, work and energy, momentum, circular motion, gravitation, waves, phases of matter, heat, and the laws of thermodynamics. Four lectures and one two-hour laboratory per week. *Prerequisite: high school trigonometry; or GMTH-1030 Precalculus or equivalent.* (Fee: \$100)
- PHYS-1020 College Physics II–Sp** **5 hours**  
Basic concepts of electricity and modern physics. Topics include electricity, magnetism, AC circuits, geometrical and physical optics, relativity theory, quantum theory and other modern physics topics. Four lectures and one two-hour laboratory per week. *Prerequisite: PHYS-1010 College Physics I or equivalent.* (Fee: \$100)
- SCED-3110 Clinical Teaching in Science–Fa,Sp** **1 hour**  
Students are assigned to assist a college instructor in classroom and laboratory teaching, evaluation, and related responsibilities. The student must complete 40 clock hours of clinical involvement in each teaching field for which licensure is desired.
- SCED-3120 Teaching Science–Fa** **2 hours**  
Designed to introduce prospective secondary school science teachers to the curriculum, materials, and methods of classroom and laboratory science teaching. Attention will be given to the philosophy and education psychology theories that are currently influencing science education and the methods of instruction that arise from these theories. Teacher education students participate in activities and complete assignments designed to provide experience in science lesson planning, acquisition of classroom and laboratory resources, and strategies of maintaining science laboratory safety. *Prerequisite: admission to the teacher education program.*
- Biology**
- BIO-1110 Introduction to Cell Biology–Fa** **5 hours**  
Foundational knowledge of cell biology including basic mechanisms of prokaryotic and eukaryotic metabolism, division, and physiology. Four lectures and one three-hour laboratory per week. (Fee \$100)
- BIO-1120 General Zoology and Population Dynamics–Sp** **5 hours**  
This course will provide an integrative study of the diversity of organisms that make up the animal kingdom. Morphology, physiology and ecology of the major phyla will be integrated with principles of population dynamics to study the continuities and discontinuities among the animal taxa. *Prerequisite: BIO-1110 Introduction to Cell Biology.* (Fee: \$100)
- BIO-2000 General Ecology–Sp (2003 only)** **4 hours**  
A semester transition version of BIO-200, General Ecology. Study of the interrelationships between living organisms and environment with emphasis upon environmental physiology, ecosystem and community ecology, and environmental stewardship. Laboratories feature field studies of representative aquatic and terrestrial ecosystems. Three (or four) lectures and one four-hour (or three-hour) laboratory, totaling seven contact hours per week. *Prerequisites: BIO-1110 Introduction to Cell Biology; BIO-2130 General Botany and Ecology.* (Fee: \$100)
- BIO-2130 General Botany and Ecology–Fa** **5 hours**  
A study of the autotrophs, their fundamental role in aquatic and terrestrial ecosystems, and their anatomy and physiology with emphasis on the vascular plants. Investigations of ecosystem level processes and field botany will be conducted in early autumn, followed by the anatomy and physiology of autotrophs after mid-semester. Four lectures and one 3-hour laboratory per week. *Prerequisites: BIO-1110 Introduction to Cell Biology; and BIO-1120 General Zoology and Population Dynamics.* (Fee: \$100)
- BIO-2210 Microbiology–Fa** **4 hours**  
A study of the characteristics, culture, and control of bacteria, viruses, and fungi. A major emphasis is placed on microorganisms and disease, with some coverage of industrial and environmental topics. Laboratory techniques are emphasized in the laboratory. Two lectures and two two-hour laboratories per week. *Prerequisite: CHEM-1000 Principles of Chemistry; CHEM-1010 Principles of Biochemistry, or equivalent.* (Fee: \$100)
- BIO-2800 Introduction to Research Methods–Fa,Sp** **2 hours**  
This course will provide guidance and experience in writing the components of a research proposal. The final assignment will consist of a short research proposal on a topic of the student's choosing. In addition, there will be an attendance requirement of 5 biology seminars during the semester in which the student registers for this course. *Prerequisites: permission of instructor; BIO-1110 Introduction to Cell Biology; BIO-1120 General Zoology and Population Dynamics.*
- BIO-3300 Genetics–Sp** **4 hours**  
This is an integrative course of the areas of genetics: classical and molecular. Focus will be on the principles of heredity in prokaryotic and eukaryotic organisms, which includes the understanding of transmission genetics on a molecular level. There will be emphasis on the molecular nature of genes, including gene expression, mutations and manipulation of DNA. Three lectures and one 3-hour laboratory per week. *Prerequisite: BIO-1110 Introduction to Cell Biology.* (Fee: \$100)
- BIO-3410 Invertebrate Zoology–Fa** **3 hours**  
This course will provide an overview of the diversity of invertebrates. It will take an integrative approach to learning about invertebrate taxonomy, ecology, morphology and physiology. Field collections of local fauna will be used to learn the principles of invertebrate classification and to study local biological diversity. *Prerequisite: BIO-1120 General Zoology and Population Dynamics.* (Fee: \$100) (even years)
- BIO-3420 Vertebrate Zoology–Fa** **3 hours**  
This course is a study of the diversity among the vertebrate classes with an emphasis on continuity and discontinuity of morphological form and physiological function of vertebrate systems. *Prerequisite: BIO-1120 General Zoology and Population Dynamics.* (Fee: \$100)
- BIO-3450 Human Structure and Function I–Fa** **3 hours**  
Study of the structure and function of the human body with an emphasis on body systems. Includes human tissues, skeletal, muscular, nervous, and endocrine systems. Two lectures and one three-hour laboratory per week. *Prerequisite: BIO-1120 General Zoology and Population Dynamics.* (Fee: \$100)
- BIO-3460 Human Structure and Function II–Sp** **3 hours**  
Study of the structure and function of the human body with an emphasis on body systems. Includes cardiovascular, respiratory, gastrointestinal, and renal systems. Three lectures per week. *Prerequisite: BIO-3450 Human Structure and Function I.*
- BIO-3510 Plant Physiology–Sp** **3 hours**  
A study of the physiological aspects of vascular plants with emphasis upon plant-soil water relationships, mineral nutrition, photosynthesis and plant growth and development. Two lectures and one 3-hour laboratory per week. *Prerequisite: BIO-2130 General Botany and Ecology.* (Fee: \$100) (odd years)
- BIO-3520 Plant Taxonomy–Sp** **3 hours**  
A study of the naming and classification of common vascular plants with emphasis upon field identification in the context of plant community and taxonomic family, plant collecting and herbarium techniques, and the importance of plants in global stewardship and missions. Two lectures and one 3-hour laboratory per week. Includes a travel study opportunity during Spring break. *Prerequisite: BIO-2130 General Botany and Ecology.* (Fee: \$100) (even years)

# Science and Mathematics

## School of Engineering, Nursing, and Science

### **BIOA-3600 Topics in Environmental Biology–Sp,Su 4 hours**

Enrollment in this course signifies that the student has chosen to enroll in two or more Au Sable Institute courses in an upcoming term taught by faculty of various evangelical Christian colleges and universities. Course descriptions of the more than twenty Cedarville-approved Au Sable courses are available in the Au Sable Institute Bulletin available from the department Au Sable representative or at the Au Sable website. Enrollment begins when the student contacts the departmental Au Sable representative. Appropriate course titles will appear in the student's transcript with letter grades when the studies are completed. More information on Au Sable Institute is printed in the university catalog. *Prerequisite: acceptance to attend Au Sable Institute.*

### **BIO-3610 Environmental Physiology and Ecology–Sp 4 hours**

A study of both physiological ecology and field ecology. The course begins with field and laboratory studies of adaptations to winter at the organismic and cellular levels and includes a travel study experience in the "North Woods." Spring emphasis shifts to field ecology with emphasis on aquatic, forest, and prairie ecosystems. Three lectures and one 3-hour laboratory per week. *Prerequisites: BIO-1120 General Zoology and Population Dynamics; BIO-2130 General Botany and Ecology.* (Fee: \$100)

### **BIO-3710 Biochemistry–Fa 4 hours**

A study of the chemical and physical properties of living organisms' macromolecules such as proteins, carbohydrates, lipids and nucleic acids and integration of metabolic pathways. Three lectures and one 3-hour laboratory per week. *Prerequisites: BIO-1110 Introduction to Cell Biology and CHEM-3510 Organic Chemistry I.* (Fee: \$100)

### **BIO-3770 Pathophysiology–Sp 3 hours**

Study of the abnormal functions of the human body during disease. Includes case study discussions and research writing. Three lectures per week. *Prerequisites: BIO-3460 Human Structure and Function II (may be taken concurrently).*

### **BIO-3800 Biological Research I–Fa,Sp 2 hours**

Student will undertake an original research project under the direction of a departmental faculty mentor, an approved mentor within a summer research program, or within an approved academic internship experience, geared toward completion of the capstone experience. *Prerequisite: junior status; permission of instructor; and BIO-2800 Introduction to Research Methods.* (Fee: \$150)

### **BIO-4210 Advanced Cell Biology–Sp 4 hours**

In-depth study of the cell will include the following topics: normal cell physiology and division, differentiation, basic signaling pathways and programmed cell death. Some study of cell pathogenesis, aberrant signaling mechanisms, and other elective topics of current agricultural or biomedical interest may be included. Three lectures and one (3-hour) laboratory per week. *Prerequisites: BIO-1100 Introduction to Cell Biology; BIO-1120 General Zoology and Population Dynamics; BIO-2130 General Botany and Ecology; and BIO-3300 Genetics.* (Fee \$100) (odd years)

### **BIO-4220 Signal Transduction–Sp 3 hours**

Study of major cellular signaling pathways in normal function and in disease. Original research will emphasize signaling pathways, and data collected will further advance the field. Two lectures and one (3 hour) laboratory per week. *Prerequisites: BIO-1100 Introduction to Cell Biology; BIO-1120 General Zoology and Population Dynamics; BIO-2130 General Botany and Ecology; and BIO-3330 Genetics.* (Fee: \$100) (even years)

### **BIO-4300 Molecular Biology of the Cell–Fa 4 hours**

Study of the molecules which make up the living cell with emphasis on nucleic acid biology and protein biology. Other topics include origin of life, abiogenesis, and a historical analysis of the discovery of DNA and proteins. *Prerequisites: BIO-1110 Introduction to Cell Biology; CHEM-3510 Organic Chemistry.* (Fee: \$100)

### **BIO-4350 Immunology–Sp 3 hours**

Study of the human immune system, including descriptions of basic immunological phenomena, biochemistry of antibodies and antigens, the cellular and genetic components of the immune response, and immunopathology. Two lectures and one lab per week. *Prerequisite: BIO-1110 Introduction to Cell Biology.* (Fee: \$100)

### **BIO-4410 Vertebrate Embryology–Fa 3 hours**

This course is a systematic study of the mechanisms that guide vertebrate development from a single cell to a multicellular organism. Morphological studies emphasize embryonic stages in selected vertebrates including: amphibians, birds, and mammals. *Prerequisite: BIO-1120 General Zoology and Population Dynamics.* (Fee: \$100) (odd years)

### **BIO-4710 Principles of Bioethics–Fa 3 hours**

Christian principles of bioethics, with an emphasis on personhood and the sanctity of human life. Three lectures per week. *Prerequisites: completion of core biology curriculum; junior status.*

### **BIO-4800 Senior Seminar–Biology–Fa,Sp 1 hour**

In this capstone course required of all senior biology majors, students compile data from laboratory, field study, or extensive literature research and give an oral presentation. Approval of the topic must be given by the student's academic advisor. The student must also attend a minimum of 10 seminars during the senior year. *Prerequisites: BIO-1110 Introduction to Cell Biology; BIO-1120 General Zoology and Population Dynamics; BIO-2130 General Botany and Ecology; BIO-3300 Genetics; BIO-2800 Introduction to Research Methods; senior Status; attendance of a minimum of 10 seminars prior to the senior year.*



Full-time professors, rather than teaching assistants, work closely with students during laboratory sessions.

**BIO-4880 Topics in Biology** **1-3 hours**

Topics of special interest by the biology faculty from the areas of modern biology. *Prerequisites:* BIO-1110 *Introduction to Cell Biology*; BIO-1120 *General Zoology and Population Dynamics*; BIO-2130 *General Botany and Ecology*; and BIO-3300 *Genetics*.

**BIO-4900 Independent Study: Biology–Fa,Sp** **1-3 hours**

Supervised independent study of a particular biological phenomenon. Submission and approval of a research proposal must precede registration. *Prerequisites:* major in biology; permission of advisor.

**BIO-4910 Environmental Biology Internship–Fa,Sp** **4 hours**

An opportunity to participate in an internship experience involving research projects with field biologists, ecologists, environmental health scientists, or environmental educators depending upon the student's vocational preference. Involves department faculty or faculty in conjunction with local or state agencies or private institutions. Provides practical experience in field biology and ecology techniques related to habitat characterization, monitoring, management, and restoration. *Prerequisites:* BIO-1120 *Zoology and Population Dynamics*; BIO 2130 *General Botany and Ecology*; BIO-2800 *Introduction to Research Methods*; and permission of instructor. (Fee: \$25)

**Chemistry**

**CHEM-1110 General Chemistry I–Fa** **4 hours**

Fundamental concepts of physical, inorganic, and analytical chemistry are developed. Students are introduced to the physical chemistry concepts of atomic theory, chemical bonding, molecular structure, intermolecular forces, states of matter, and thermodynamics. Inorganic concepts of reaction types and stoichiometry are included. Lab stresses analytical techniques including quantitation, separation, titration, and statistical analysis of data. Many of the lab reports require use of spreadsheets or other computer software. Three lectures and one three-hour lab per week. *Prerequisite:* satisfactory performance on the chemistry placement exam. (Fee: \$100)

**CHEM-1120 General Chemistry II–Sp** **4 hours**

A continuation of General Chemistry I including the physical chemistry concepts of kinetics and equilibrium. Inorganic topics include acids & bases, oxidation-reduction reactions, nuclear chemistry, and the descriptive chemistry of the main group and transition metal elements. Lab exercises stress quantitative analytical techniques and include application of visible light spectroscopy. Many of the lab reports require use of spreadsheets or other computer software and statistical analysis of data. Three lectures and one three-hour lab per week. *Prerequisite:* CHEM-1110 *General Chemistry I*. (Fee: \$100)

**CHEM-2210 Analytical Chemistry I–Fa** **3 hours**

A study of the fundamental concepts and skills of analytical chemistry including measurement, statistical treatment of data, equilibrium constant calculations, acid-base equilibria, electrochemistry, and volumetric analysis. The laboratory sessions focus on volumetric methods such as precipitation titrations, acid-base titrations, complexation titrations, and redox titrations in which accurate measurement of volume is essential. Two lectures and one three-hour laboratory per week. *Prerequisite:* CHEM-1120 *General Chemistry II*. (Fee: \$100)

**CHEM-2220 Analytical Chemistry II–Sp** **3 hours**

Detailed study of analytical instrumentation including electro-analytical methods such as potentiometry, coulometry, voltammetry, spectrochemical analysis, and analytical separations, including various types of chromatography. Two lectures and one three-hour laboratory per week. *Prerequisite:* CHEM-2710 *Analytical Chemistry I*. (Fee: \$100)



*Creation Science is one way Cedarville faculty help students develop a biblical world-life view.*

**CHEM-2800 Introduction to Research in Chemistry–Fa** **1 hour**

An introduction to the purpose and methodology of research in chemistry including keeping a laboratory notebook, retrieving information, using the chemical literature, and writing research reports. One lecture per week. *Prerequisite:* CHEM-1120 *General Chemistry II*. (Fee: \$100)

**CHEM-3410 Inorganic Chemistry–Fa** **3 hours**

Detailed study of inorganic compounds including atomic structure, the structure of solids, molecular structure and bonding, molecular symmetry and its applications, acids and bases, and oxidation and reduction. Lab stresses synthesis and characterization using instrumental methods. Two lectures and one three-hour lab per week. *Prerequisite:* CHEM-2710 *Analytical Chemistry I*. (Fee: \$100)

**CHEM-3510 Organic Chemistry I–Fa** **5 hours**

Detailed study of the structure, nomenclature, stereochemistry, physical properties, spectra, syntheses, reactions, and reaction mechanisms of alkanes, alkenes, alkynes, alkyl halides, alcohols, and ethers. Biological and medical applications are included. Lab includes basic techniques, procedures, and instruments, as well as syntheses and reactions. Four lectures and one three-hour lab per week. *Prerequisite:* CHEM-1120 *General Chemistry II*. (Fee: \$100)

**CHEM-3520 Organic Chemistry II–Sp** **5 hours**

Continuation of Organic Chemistry I including the detailed study of conjugated aliphatics, aromatics, aldehydes, ketones, carboxylic acids, anhydrides, esters, acyl halides, amines, phenols, and aryl halides. Lab includes systematic qualitative organic analyses using modern instrumental methods (H-NMR, C-NMR, FTIR, GC/MS). Three lectures and two three-hour labs per week. *Prerequisite:* CHEM-3510 *Organic Chemistry I*. (Fee: \$100)

**CHEM-3710 Biochemistry–Fa** **4 Hours**

A study of the chemical and physical properties of living organisms' macromolecules such as proteins, carbohydrates, lipids and nucleic acids and integration of metabolic pathways. Three lectures and one three-hour laboratory per week. *Prerequisites:* BIO-1110 *Introduction to Cellular Biology*; CHEM-3510 *Organic Chemistry I*. (Fee: \$100)

# Science and Mathematics

## School of Engineering, Nursing, and Science

### **CHEM-4210 Advanced Chemistry Lab–Sp 2 hours**

This laboratory course will integrate organic and inorganic synthetic methodology along with the application of various characterization techniques. Analytical, physical, and instrumental analysis techniques will be utilized. One three-hour lab per week. *Prerequisite: CHEM-4320 Physical Chemistry II.* (Fee: \$100)

### **CHEM-4310 Physical Chemistry I–Fa 4 hours**

A study of the laws of thermodynamics, chemical equilibrium, solutions and kinetics. Three lectures and one three-hour lab per week. *Prerequisites: CHEM-2210 Analytical Chemistry I, PHYS-2120 General Physics II.* (Fee: \$100)

### **CHEM-4320 Physical Chemistry II–Sp 4 hours**

A study of the states of matter, surface phenomena, quantum mechanics, bonding, and spectroscopy. Three lectures and one three-hour lab per week. *Prerequisite: CHEM-4310 Physical Chemistry I.* (Fee: \$100)

### **CHEM-4410 Advanced Inorganic Chemistry–Sp 3 hours**

Study of d-metal complexes, the systematic chemistry of the elements and advanced topics in inorganic chemistry. Topics may include main group organometallics, d- and f-block elements, catalysis, and bioinorganic chemistry. Three lectures per week. *Prerequisite: CHEM-3410 Inorganic Chemistry.*

### **CHEM-4800 Senior Seminar–Chemistry–Sp 1 hour**

Capstone course for majors in chemistry. Students present a paper from library or laboratory research. Before enrollment, each student must obtain approval of the topic from his or her advisor and the seminar instructor and set the date of presentation. The students must also attend a minimum of 10 seminars during the senior year. Guest lecturers or faculty members may present papers at the invitation of the instructor. *Prerequisite: senior status; and attendance of a minimum of 10 seminars during the sophomore and junior years.*

### **CHEM-4830 Research in Chemistry–Sp 3 hours**

Investigation of a chemical research project and its culmination in a scholarly research report. Submission and approval of a research proposal must precede registration. May be repeated once for credit. *Prerequisite: CHEM-2800 Introduction to Research in Chemistry; CHEM-4310 Physical Chemistry I.* (Fee: \$150)

### **CHEM-4880 Topics in Chemistry 1-3 hours**

Topics of special interest are selected by the chemistry faculty from the areas of modern chemistry. *Prerequisites: CHEM-2210 Analytical Chemistry I; junior status; and permission of instructor.*

### **CHEM-4900 Independent Study in Chemistry 1-3 hours**

Supervised independent study of some chemical phenomenon. Submission and approval of a research proposal must precede registration. *Prerequisites: CHEM-2210 Analytical Chemistry I; CHEM-3510 Organic Chemistry I; and CHEM-4310 Physical Chemistry I.*

## **Computer Science**

### **CS-1210 C++ Programming–Fa,Sp 2 hours**

This course will introduce students to computer programming using the C++ programming language. The course will introduce software engineering principles, structured program design and implementation, and object-oriented design. Students will become familiar with compiling programs in both the Unix and Windows operating systems. (Fee: \$50)

### **CS-1220 Object-Oriented Design with C++–Fa,Sp 3 hours**

Builds upon the C++ programming skills developed in CS-1210, introducing students to the object paradigm and the basics of software engineering. Students will apply the principles of object-oriented design on programming tasks in both the Unix and Windows environments. Intended as the second programming

course for CS majors. *Prerequisite: CS-1210 C++ Programming.* (Fee: \$50)

### **CS-2210 Data Structures Using Java–Fa,Sp 3 hours**

This course will introduce students to the proper use of data structures for developing efficient software. Data structures will include stacks, queues, priority queues, trees, and graphs. Students will also develop skill in object-oriented design and Java programming. *Prerequisite: CS-1220 Object-Oriented Design with C++.* (Fee: \$50)

### **CS-3210 Programming Language Survey–Sp 3 hours**

Systematic study of the principles, concepts, and mechanisms of computer programming languages: their syntax, semantics, and pragmatics; the processing and interpretations of computer programs; programming paradigms; and language design. Illustrative examples will be selected from a variety of programming language paradigms. *Prerequisite: CS-2210 Data Structures Using Java.* (Fee: \$50)

### **CS-3310 Operating Systems–Fa 3 hours**

A state of the art survey of operating system principles. Covers fundamental technology as well as contemporary design issues, such as threads, real-time systems, multiprocessor scheduling, distributed systems, security, and object-oriented design. Course content is developed through the use of lectures, student research of the relevant literature, presentations, and programming projects using both C++ and Java. *Prerequisite: CS-2210 Data Structures Using Java.* (Fee: \$50)

### **CS-3410 Algorithms–Fa 3 hours**

This course will introduce students to classic algorithms which have been developed and shown to have broad application in solving computer science problems. The course will begin with a look at the analysis of algorithms, and then survey numerous useful algorithms and advanced data structures. The course will also cover special topics such as numeric methods and NP-completeness. *Prerequisite: CS-2210 Data Structures Using Java.* (Fee: \$50)

### **CS-3510 Compiler Theory and Practice–Sp 3 hours**

This course will introduce students to the technology underlying modern compilers. The course will emphasize both the theory upon which compilers are based and a practical understanding of how to actually implement a compiler. This course will provide an excellent application for the object-oriented design and data structures skills learned in earlier courses. The course will typically require a major project involving the development of an actual compiler. *Prerequisite: CS-3410 Algorithms.* (Fee: \$50) (even years)

### **CS-4220 Web Applications–Sp 3 hours**

This course will introduce students to the design and development of web-based applications. Students will use tools such as PERL, javascript, JSP, and java servlets. Applications will be developed using both the IIS and Apache servers. *Prerequisite: CS-2210 Data Structures Using Java.* (Fee: \$50)

### **CS-4320 Network Security–Fa 3 hours**

Practical topics in network security, including policy, malicious code, intrusion detection, prevention, response, and cryptographic protocols for privacy and integrity. An emphasis will be on the tradeoffs between risk of misuse, cost of prevention, and societal issues. Course topics will be reinforced through programming assignments. *Prerequisite: CS-3310 Operating Systems.* (Fee: \$50)

### **CS-4810 Software Engineering I–Fa 3 hours**

Introduction to software engineering principles focusing on software management concepts, software project scheduling, software quality assurance, and software project planning. Students will work in teams to analyze and design a large senior project, which will be completed in CS-4820. *Prerequisite: CS-3410 Algorithms.* (Fee: \$50)

# Science and Mathematics

## School of Engineering, Nursing, and Science

**CS-4820 Software Engineering II–Sp** **4 hours**

Builds upon the software analysis and design skills learned in Software Engineering I. Focuses on detailed design, implementation, testing, and maintenance of software projects. Students will complete the senior design project they started in CS-4810. *Prerequisite: CS-4810 Software Engineering.* (Fee: \$50)

**CS-4880 Topics in Computer Science** **1-3 hours**

Study of topics of interest from the field of computer science, such as compiler theory, artificial intelligence, parallel computing, robotics, advanced algorithms, and numeric methods. *Prerequisite: permission of instructor.* (Fee: \$20/hour)

**CS-4900 Independent Study in Computer Science** **1-3 hours**

Independent research in the various branches of computer science and allied fields of application. Submission and approval of a research proposal must precede registration. *Prerequisite: major in computer science; and permission of the research instructor.* (Fee: \$5/hour)

**Mathematics**

**MATH-1710 Calculus I–Fa,Sp** **5 hours**

First course of a two-course sequence covering basic concepts of analytic geometry and single variable calculus. Includes limits, transcendental functions, derivatives, applications of the derivative, single variable integration with introduction to numeric integration techniques, applications of integration including some solutions of differential equations, and additional integration techniques. *Prerequisites: GMTH-1030 Precalculus or equivalent; or permission of instructor.*

**MATH-1720 Calculus II–Fa,Sp** **5 hours**

The second course of a two-course sequence covering the basic concepts of analytic geometry and single variable calculus. Includes sequences, series, expansion of functions into Taylor and power series, conic sections, plane curves, parametric equations, polar coordinates, vectors and geometry in three-space, vectors, and vector calculus. *Prerequisites: MATH-1710 Calculus I or equivalent; or permission of instructor.*

**MATH-2210 Logic and Methods of Proof–Fa,Sp** **3 hours**

Introduction to formal mathematical logic; emphasis on preparing students for the abstraction of upper-division courses. Special attention is given to the development of students' skills with a variety of methods of proof, using examples from numerous areas. *Prerequisites: MATH-1720 Calculus II; or permission of instructor.*

**MATH-2710 Calculus III–Sp** **3 hours**

Introduction to differential and integral calculus of several variables, multiple integrals, vector analysis, line integrals, and surface integrals. *Prerequisites: MATH-1720 Calculus II or equivalent; or permission of instructor.*

**MATH-2740 Differential Equations–Fa** **3 hours**

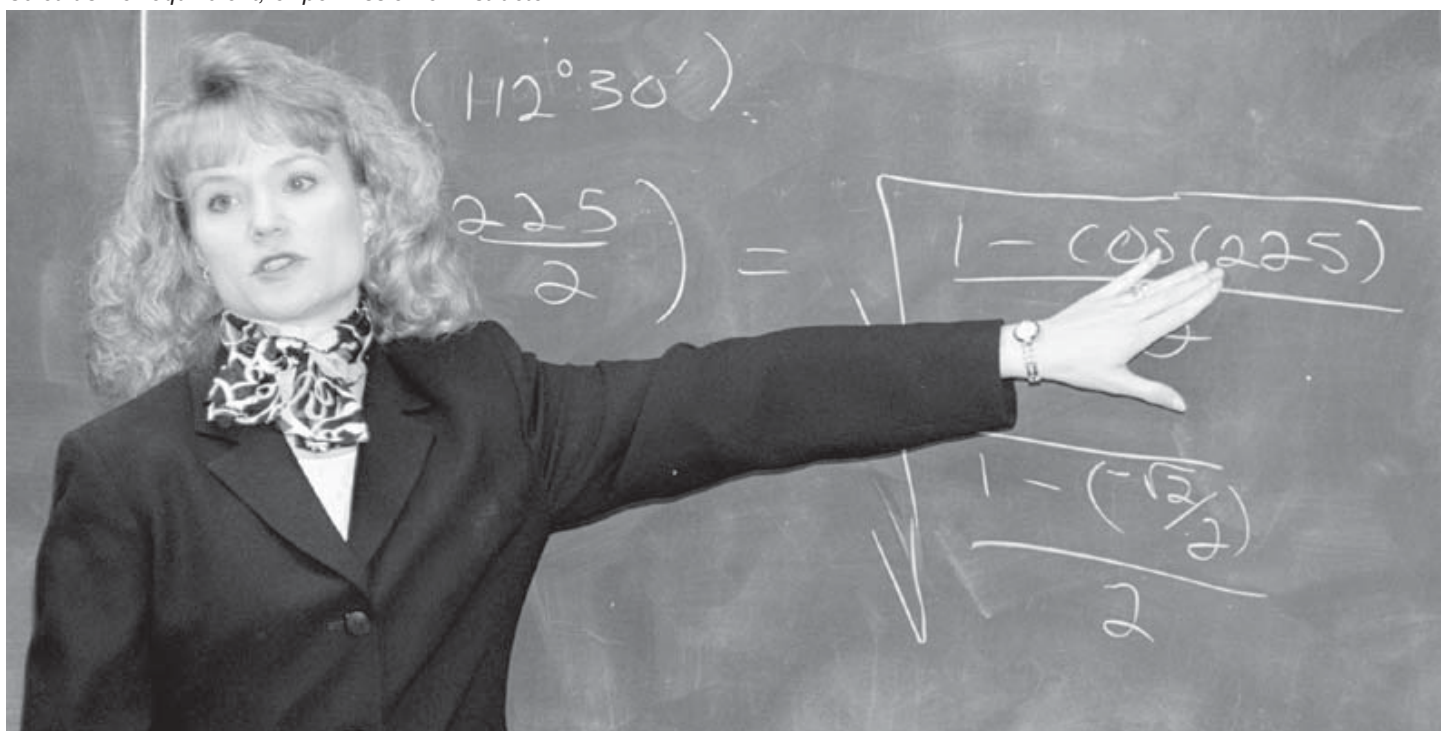
Study of the standard techniques employed in the solution of differential equations with emphasis on those arising from physical problems. *Prerequisites: MATH-1720 Calculus II or equivalent.*

**MATH-2830 Analytic Geometry and Calculus III–Fa (2002 only)** **3 hours**

This is the semester transition version of MATH-283 Analytic Geometry and Calculus III, which includes conic sections, plane curves, parametric equations, polar coordinates, vectors and geometry in three space, vectors and vector calculus. *Prerequisites: MATH-282 Analytic Geometry and Calculus II.*

**MATH-3050 Algebraic Structures for Secondary Education Majors–Fa** **3 hours**

An introduction to the basic ideas of Number Theory, Abstract Algebra and Linear Algebra. Factorization of integers, congruence modulo  $m$ , Fermat's Theorem, groups, rings, integral domains, fields, vector spaces, systems of linear equations, determinants and inverses, linear transformations, eigenvalues and eigenvectors. **Does not count towards B.A. or B.S. majors in mathematics.** *Prerequisites: MATH-2210 Logic and Methods of Proof; MATH-1720 Calculus II.*



Dedicated professors present mathematical functions with God's Word as the foundation of Truth.

# Science and Mathematics

## School of Engineering, Nursing, and Science

### **MATH-3110 Probability & Statistics I–Fa** 3 hours

Probability models, random variables, probability distributions, estimation and hypothesis tests are studied from theoretical and practical viewpoints. *Prerequisite: MATH-1720 Calculus II.*

### **MATH-3500 Number Theory–Fa** 3 hours

Introduction to most of the topics of elementary number theory such as modular arithmetic, prime factorizations, linear diophantine equations, the Chinese remainder theorem, quadratic reciprocity, Pythagorean triples, number theoretic functions, and related topics. Concrete examples will illustrate the concepts and abstract reasoning will develop the theories considered in the courses. *Prerequisite: MATH-2210 Logic and Methods of Proof.* (odd years)

### **MATH-3550 Discrete Math: Graph Theory–Fa** 3 hours

Introduction to the basic concepts of graph theory and discrete mathematics problem-solving. Topics covered include elements of graph theory, covering circuits, graph coloring, trees and searching, and network algorithms. *Prerequisite: MATH-2210 Logic and Methods of Proof.*

### **MATH-3560 Discrete Math: Combinatorics–Sp** 3 hours

Study of combinatorial reasoning, focusing on enumeration. Intended to develop a proficiency in methods of enumerative problem solving. Topics chosen from areas such as counting methods for arrangements and selections, permutations and combinations, generating functions, partitions and recurrence relations. *Prerequisite: MATH-2210 Logic and Methods of Proof.* (odd years)

### **MATH-3610 Linear Algebra–Sp** 3 hours

Introduction to the algebra of linear equations, including determinants, matrices, vector spaces, eigenvalues, eigenvectors, and linear mappings. *Prerequisite: MATH-1720 Calculus II or equivalent.*

### **MATH-3710 Advanced Calculus–Sp** 3 hours

Topics in function theory, vector analysis, differential calculus of several variables, vector differential calculus of several variables, integral calculus of several variables, vector integral calculus of several variables, and infinite series. *Prerequisite: MATH-2710 Calculus III or equivalent; or permission of instructor.* (even years)

### **MATH-3740 Complex Variables–Sp** 3 hours

Introduction to complex arithmetic, differentiation: analytic functions, Cauchy-Riemann equations, harmonic functions, elementary functions and their mapping properties, integration: Cauchy's Theorem, Cauchy's Integral Formula, Taylor and Laurent series, poles, residues and the residue theorem. *Prerequisite: MATH-1720 Calculus II.* (odd years)

### **MATH-3800 Research Methods–Sp** 1 hour

This course will introduce the mathematics major to the various resources and methods available for researching topics in mathematics. This could include the use of library resources at Cedarville University, use of Internet resources, WWW searches, and a tour of the library at a larger university, where journals and indices of importance can be referenced. *Prerequisites: MATH-2210 Logic and Methods of Proof; ENG-1400 English Composition.* (Fee: \$50)

### **MATH-4110 Probability and Statistics II–Sp** 3 hours

Second course of a two-course sequence covering basic concepts of statistics. Topics chosen from the following: hypothesis tests, regression analysis, quality control, and non-parametric statistics. *Prerequisites: MATH-3110 Probability and Statistics I.*

### **MATH-4210 Mathematical Methods for Physicists–Fa** 3 hours

Advanced mathematical methods used in the solution of physics problems. Topics include curvilinear coordinates, vector analysis, and solutions to partial differential equations using Fourier, Bessel and Legendre functions. *Prerequisites: MATH-2710 Calculus III; MATH-2740 Differential Equations.* (even years)

### **MATH-4410 Euclidean and Non-Euclidean Geometry–Sp** 3 hours

Rigorous treatment of the foundations of Euclidean geometry; an introduction to hyperbolic geometry with emphasis on its Euclidean models. *Prerequisite: MATH-2210 Logic and Methods of Proof.* (even years)

### **MATH-4450 Topology–Fa** 3 hours

An introduction to elementary point set topology with emphasis on illustrating how the familiar concepts of closed and open intervals, continuity of functions, distances, and various geometrical properties have been generalized from classical mathematics. Topics include: metric spaces, topological space theory, separation axioms, covering properties, compactness, connectedness, metrizable, and complete metric spaces. *Prerequisite: MATH-2210 Logic and Methods of Proof.* (even years)

### **MATH-4610, 4620 Abstract Algebra I, II–Fa,Sp** 3 hr/sem

Introduction to and development of the basic ideas of algebraic systems, groups, rings, integral domains, fields and other advanced topics. *Prerequisite: MATH-2210 Logic and Methods of Proof.* (even years)

### **MATH-4710, 4720 Real Variables I, II–Fa,Sp** 3 hr/sem

Introduction to the real number system's algebraic, order, completeness, and cardinality properties, the topology of Cartesian spaces  $\mathbb{R}^n$  and functions including continuity and uniform continuity, connectedness, convexity, compactness, various types of convergence, limits, differentiability, and Riemann integration, measurability, and  $L_n$ . *Prerequisites: MATH-1720 Calculus II; MATH-2210 Logic and Methods of Proof.*

### **MATH-4800 Capstone Experience in Mathematics–Fa,Sp** 1 hour

The course will allow students to deeply research an important topic in mathematics, both individually and collectively, and to present their findings from library research as well as personal work. *Prerequisites: MATH-3800 Research Methods in Mathematics; 15 hours of courses beyond MATH-1720 Calculus II, and permission of instructor.* (Fee: \$20)

### **MATH-4880 Topics in Mathematics–Fa,Sp** 1-3 hours

Some typical topics are linear programming, numerical analysis, stochastic calculus, non-parametric statistics, partial differential equations, or mathematical modeling. This course is intended to be a topic, not in the current curriculum, that is a logical extension and development of the student's academic plan. *Prerequisite: permission of instructor.*

### **MATH-4900 Independent Study in Mathematics–Fa,Sp** 1-3 hours

Independent research in the various branches of mathematics and allied fields of application. Submission and approval of a research proposal must precede registration. *Prerequisites: major in mathematics; or permission of research advisor.*

## **Physics**

### **PHYS- 2110 General Physics I–Fa,Sp** 4 hours

Basic concepts of linear and rotational motion in three dimensions, oscillatory motion, gravitation, fluid mechanics, and basic concepts of wave motion. Three lectures and one two-hour laboratory per week. *Prerequisite: MATH-1710 Calculus I; MATH-1720 Calculus II; MATH-1720 may be co-enrolled with permission of instructor.* (Fee: \$100)

### **PHYS- 2120 General Physics II–Fa,Sp** 4 hours

Basic concepts of electricity and magnetism, light, and optics. Three lectures and one two-hour laboratory per week. *Prerequisite: MATH-1720 Calculus II; PHYS-2110 General Physics I.* (Fee: \$100)

# Science and Mathematics

## School of Engineering, Nursing, and Science

### **PHYS- 2130 General Physics III–Sp 2 hours**

Basic concepts of heat and thermodynamics, and a basic introduction to modern physics, including introductory concepts of relativity and quantum theory. *Prerequisites: MATH-1720 Calculus II; PHYS-2120 General Physics II; PHYS-2120 General Physics II may be co-enrolled with permission of instructor.*

### **PHYS-3110 Intermediate Physics Laboratory–Sp 2 hours**

Designed to reinforce concepts of the advanced physics courses and develop critical research and analysis skills. This course provides laboratory experience in such topics as oscillatory motion and waves, mechanics, electricity and magnetism, thermodynamics and quantum mechanics. During this semester the student will develop their prospectus for their Advanced Laboratory project. Laboratory skills for planning, setup, documentation, and analysis using the scientific method will be emphasized. *Prerequisite: 3 hours of a 3000- or 4000-level physics course. (Fee: \$100)*

### **PHYS-3310 Theoretical Mechanics–Sp 3 hours**

Derivation of the motion of a point object through three-dimensional space. Topics include an advanced treatment of Newtonian mechanics in three dimensions, oscillatory motion, accelerated frames of reference, central forces, and an introduction to Lagrangian mechanics. *Prerequisites: PHYS-2120 General Physics II; MATH-2740 Differential Equations; MATH-2740 may be co-enrolled with permission of instructor. (even years)*

### **PHYS-3350 Thermal Physics–Fa 3 hours**

Study of the relationship between energy and matter through the use of thermodynamics and statistical mechanics. Topics include the laws of thermodynamics, heat, work, entropy, phase transformations, statistical distributions, and kinetic theory. *Prerequisite: PHYS-2130 General Physics III. (odd years)*

### **PHYS-3410 Electromagnetic Theory I–Fa 3 hours**

Electricity and magnetism from an advanced viewpoint using the methods of vector calculus. Includes electrostatics, Gauss' Law, Poisson's equation, Laplace's equation, dielectric media, electric currents, and magnetostatics. *Prerequisites: PHYS-2120 General Physics II; MATH-2710 Calculus III. (odd years)*

### **PHYS-3510 Modern Physics I–Fa 3 hours**

Introduction to relativity theory, quantum theory including Schrodinger's Equation and its basic applications, atomic structure. *Prerequisite: PHYS-2130 General Physics III. (even years)*

### **PHYS-3800 Research Methods in Physics–Fa 1 hour**

Designed to reinforce concepts of the advanced physics courses and develop critical research and analysis skills. This course will focus on basic library, research, and laboratory skills for planning, setup, documentation, and analysis using the scientific method. Selected software will be introduced and used to collect data, analyze results, and document findings. There will be several laboratory sessions with experiments selected from oscillatory motion and waves, intermediate mechanics, intermediate elec-tricity, intermediate magnetism, thermodynamics, or quantum mechanics. *Prerequisite: PHYS-2130 General Physics III. (Fee: \$50)*

### **PHYS-4110 Advanced Physics Laboratory–Fa 2 hours**

The advanced laboratory experience is designed to reinforce concepts of the advanced physics courses and to develop critical research design, documentation, analysis, and presentation skills. The Advanced Laboratory provides additional experience in optical, radiation, wave, advanced mechanics, advanced electromagnetism, advanced thermodynamics, and quantum mechanics. During this semester the students will be conducting their Advanced Laboratory project, collecting data, and documenting results. Laboratory skills for planning, setup, documentation, analysis, and briefing using the scientific method

will be emphasized. *Prerequisite: PHYS-3110 Intermediate Physics Lab. (Fee: \$100)*

### **PHYS-4210 Mathematical Methods for Physicists–Fa 3 hours**

Advanced mathematical methods used in the solution of physics problems. Topics include curvilinear coordinates, vector analysis, and solutions to partial differential equations using Fourier, Bessel and Legendre functions. *Prerequisites: MATH-2710 Calculus III; MATH-2740 Differential Equations; 3 hours of a 3000 or 4000 level physics course. (even years)*

### **PHYS-4410 Electromagnetic Theory II–Sp 3 hours**

Continuation of PHYS-3410. Includes magnetic properties of matter, electromagnetic induction, magnetic energy, slowly varying currents, Maxwell's equations and their applications, and introductory electrodynamics. *Prerequisite: PHYS-3410 Electromagnetic Theory I. (odd years)*

### **PHYS-4450 Optics–Sp 3 hours**

Introduction to the study of classical and modern optics, including geometric optics, wave optics, and quantum optics. Topics include thin lenses, thick lenses and systems of lenses, mirrors, aberrations, lens design, interference, coherence, diffraction, polarization, and holography. *Prerequisites: PHYS-2120 General Physics II; MATH-2710 Calculus III. (odd years)*

### **PHYS-4510 Modern Physics II–Sp 3 hours**

Introduction to statistical physics, solid state, superconductivity, nuclear structure, kinetic theory, nuclear physics applications and particle physics. *Prerequisite: PHYS-3510 Modern Physics I. (even years)*

### **PHYS-4800 Senior Seminar–Physics–Sp 1 hour**

A presentation of the basic principles of the major disciplines of the sciences with a focus on the inter-relationships of the science disciplines to each other. Students present a paper from library or laboratory research in their area of physics with a focus on integration. Each student must obtain approval of the topic from his/her advisor and seminar instructor and must set the date of presentation before enrolling in the course. Material for this course is an outgrowth of a topic chosen by the student in PHYS-4110 Advanced Physics Lab. A paper and oral presentation are required, which includes the background, setup, data collection, analysis, and conclusions from his/her research. Guest lecturers and faculty members may present papers at the invitation of the instructor. *Prerequisite: PHYS-4110 Advanced Physics Lab; and permission of instructor.*

### **PHYS-4880 Topics in Physics 1-3 hours**

Study of topics of interest from modern and classical physics such as quantum theory, relativity, statistical mechanics, lasers, solid state physics, advanced classical mechanics, and atmospheric physics. *Prerequisites: PHYS-2130 General Physics III; MATH-2710 Calculus III.*

### **PHYS-4900 Independent Study in Physics 1-3 hours**

Independent research in the various branches of physics and allied fields of application. Submission and approval of a research proposal must precede registration. *Prerequisite: permission of instructor. (Fee: \$25/hour)*